

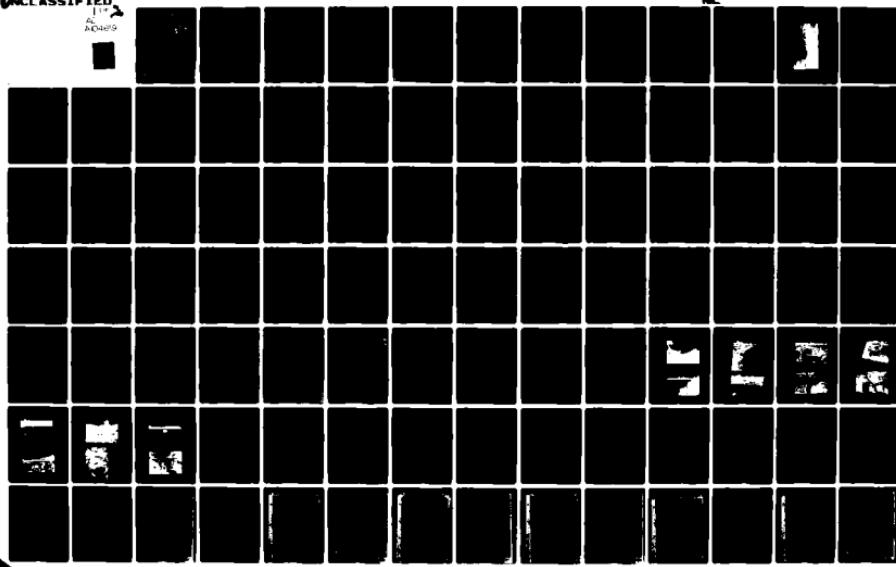
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MONROE CITY SOUTH LAKE DAM
MONROE COUNTY, MISSOURI
MO. 10538

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PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

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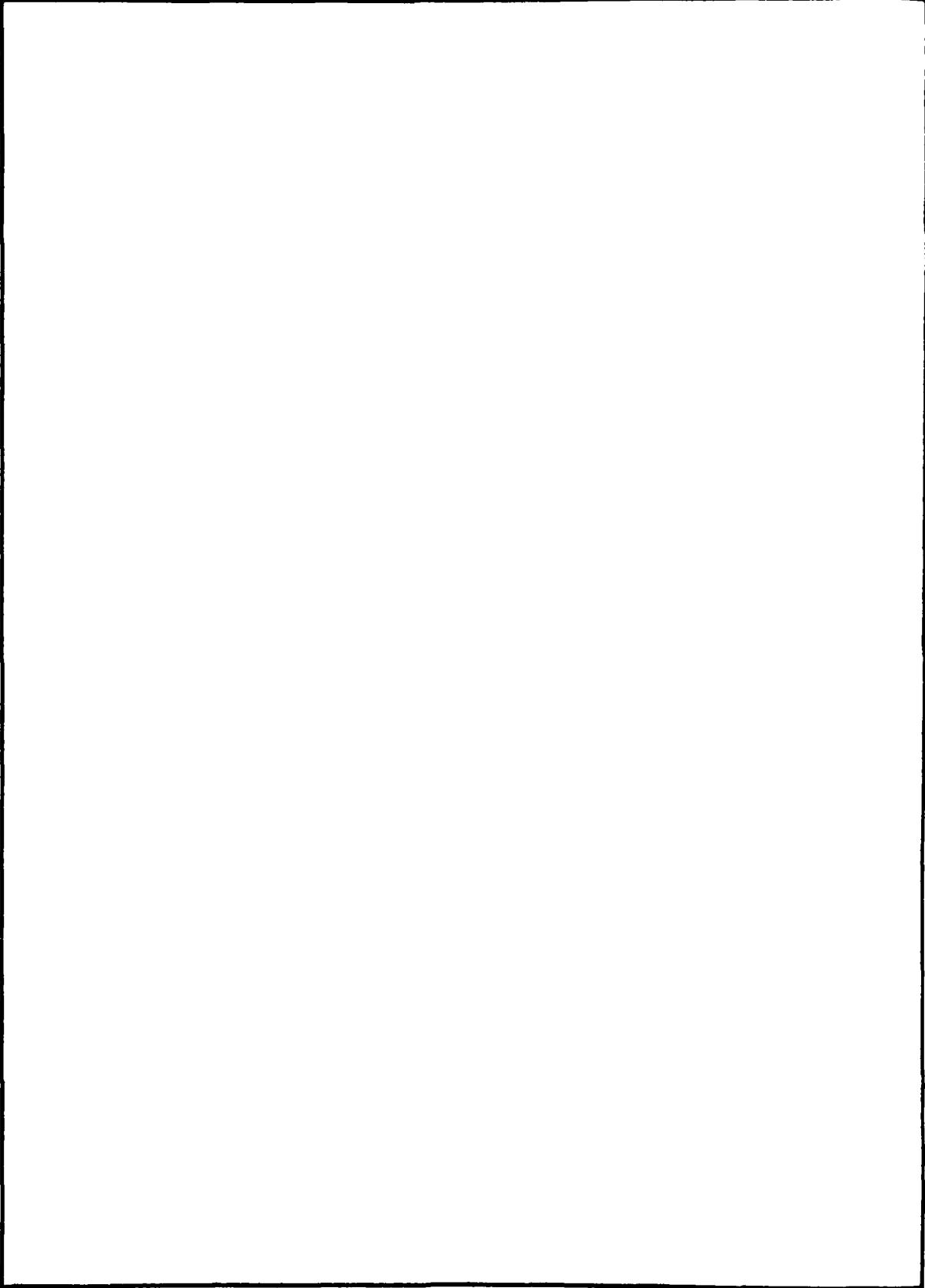
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This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.	VJL 412553	

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Monroe City South Lake Dam (Mo. 10538) Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Monroe City South Lake Dam (Mo. 10538).

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

- 1) Spillway will not pass 50 percent of the Probable Maximum Flood
- 2) Overtopping could result in dam failure
- 3) Dam failure significantly increases the hazard to loss of life downstream

SIGNED

SUBMITTED BY:

Chief, Engineering Division

17 DEC 1979

Date

SIGNED

APPROVED BY:

Colonel, CE, District Engineer

17 DEC 1979

Date

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MONROE CITY SOUTH LAKE DAM
MONROE COUNTY, MISSOURI

MISSOURI INVENTORY NO. 10538

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

Monroe City South Lake Dam # [REDACTED]
[REDACTED] (MO-10538), Mississippi-Salt-Quincy
River Basin. Monroe County, Missouri.
Phase I Inspection Report.

PREPARED BY

CONSOER, TOWNSEND AND ASSOCIATES, LTD.

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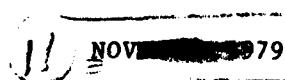
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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Monroe City South Lake Dam, Missouri Inv. No. 10538
State Located: Missouri
County Located: Monroe
Stream: Offstream of Little Indian Creek
Date of Inspection: June 12, 1979

Assessment of General Condition

Monroe City South Lake Dam was inspected by the engineering firms of Consoer, Townsend and Associates Ltd., and Engineering Consultants, Inc. (A Joint Venture) of St. Louis, Missouri using the "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed by the Chief of Engineers, U.S. Army, Washington, D.C., with the help of Federal and State agencies, professional engineering organizations, and private engineers. The resulting guidelines are considered to represent a consensus of the engineering profession.

Based on the criteria in the guidelines, the dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur in the event of failure of the dam. The estimated damage zone extends about two miles downstream of the dam. Within the damage zone are one dwelling, one pumphouse and two crossings of U.S. Highway 24, which

may be subjected to flooding, with possible damage and/or destruction, and possible loss of life. Monroe City South Lake Dam is in the small size classification since it is less than 40 feet high and impounds less than 1,000 acre-feet of water.

Our inspection and evaluation indicates that the spillway of Monroe City South Lake Dam does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. Monroe City South Lake Dam being a small size dam, with a high hazard potential, is required by the guidelines to pass from one-half of the Probable Maximum Flood to the Probable Maximum Flood without overtopping. Since there is high hazard potential downstream of the dam, the appropriate spillway design flood for this dam is the Probable Maximum Flood. It was determined that the reservoir/spillway system can accommodate 25 percent of the Probable Maximum Flood without overtopping the dam. Our evaluation indicates that the reservoir/spillway system will accommodate the 100-year flood without overtopping.

The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in the region. The 100-year flood is defined as a flood having a one percent chance of being equalled or exceeded during any given year.

It is recommended that the owner take action to correct the deficiency in the spillway capacity.

Other deficiencies noted by the inspection team were: a small depression caused by a shallow slide on the downstream slope; deteriorated concrete in the spillway and discharge apron; brush growing in the upstream slope; erosion along the upstream crest; brush growing in the discharge channel; an inoperable low level

outlet; a lack of periodic inspection by a qualified engineer and a lack of a maintenance schedule. The lack of seepage and stability analyses on record is also a deficiency.

It is recommended that the owner take action to correct or control the deficiencies described above.



Walter G. Shifrin, S.E.





Overview of Monroe City South Lake Dam

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

MONROE CITY SOUTH LAKE DAM, I.D. No. 10538

TABLE OF CONTENTS

<u>Sect. No.</u>	<u>Title</u>	<u>Page</u>
SECTION 1	PROJECT INFORMATION	1
1.1 General	1	
1.2 Description of Project	3	
1.3 Pertinent Data	8	
SECTION 2	ENGINEERING DATA	11
2.1 Design	11	
2.2 Construction	11	
2.3 Operation	11	
2.4 Evaluation	12	
SECTION 3	VISUAL INSPECTION	14
3.1 Findings	14	
3.2 Evaluation	18	

TABLE OF CONTENTS

(Continued)

<u>Sect. No.</u>	<u>Title</u>	<u>Page</u>
SECTION 4	OPERATION PROCEDURES	19
4.1	Procedures	19
4.2	Maintenance of Dam	19
4.3	Maintenance of Operating Facilities	19
4.4	Description of Any Warning System in Effect	20
4.5	Evaluation	20
SECTION 5	HYDRAULIC/HYDROLOGIC	21
5.1	Evaluation of Features	21
SECTION 6	STRUCTURAL STABILITY	25
6.1	Evaluation of Structural Stability	25
SECTION 7	ASSESSMENT/REMEDIAL MEASURES	27
7.1	Dam Assessment	27
7.2	Remedial Measures	29

TABLE OF CONTENTS

(Continued)

LIST OF PLATES

	<u>Plate No.</u>
LOCATION MAP	1
PLAN AND ELEVATION OF DAM	2
DESIGN DRAWINGS	3-8
GEOLOGIC MAPS.	9
SEISMIC ZONE MAP	10

APPENDICES

APPENDIX A - PHOTOGRAPHS

APPENDIX B - HYDROLOGIC COMPUTATIONS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

MONROE CITY SOUTH LAKE DAM, Missouri Inv. No. 10538

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

The Dam Inspection Act, Public Law 92-367 of August, 1972, authorizes the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspections. Inspection of Monroe City South Lake Dam was carried out under Contract DACW 43-79-C-0075 between the Department of the Army, St. Louis District, Corps of Engineers, and the engineering firms of Consoer, Townsend & Associates Ltd., and Engineering Consultants, Inc. (A Joint Venture), of St. Louis, Missouri.

b. Purpose of Inspection

The visual inspection of Monroe City South Lake Dam was made on June 12, 1979. The purpose of the inspection was to make a general assessment as to the structural integrity and operational adequacy of the dam embankment and its appurtenant structures.

c. Scope of Report

This report summarizes available pertinent data relating to the project; presents a summary of visual observations made during the field inspection; presents an assessment of hydrologic and hydraulic conditions at the site; presents an assessment as to the structural adequacy of the various project features; and assesses the general condition of the dam with respect to safety.

Subsurface investigations, laboratory testing, and detailed analyses were not within the scope of this study. The conclusions drawn herein, therefore, are based on the presence of, or absence of, obvious signs of distress. No warranty as to the absolute safety of the project features is implied by the conclusions presented in this report.

It should be noted that reference in this report to left or right abutments is as viewed looking downstream. Where left abutment or left side of the dam is used in this report, this also refers to south abutment or side, and right to the north abutment or side.

d. Evaluation Criteria

Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams", Appendix D. These guidelines were developed with the help of several Federal agencies and many State agencies, professional engineering organizations, and private engineers.

a. Description of Dam and Appurtenances

The following description is based largely on available drawings.

The dam consists of a zoned earth embankment between earth abutments. The crest width is 12 feet and the total length of the dam is shown as 1,008 feet on the 1937 drawing, however, the actual length was measured to be about 972 feet. The crest elevation is 716 feet above M.S.L. based on available drawings and an assumed spillway crest elevation of 713 feet. The maximum section shown on the plan has a height of about 31 feet excluding stripping.

The upstream slope of a typical section is shown as 1.0V to 2.5H, while the downstream slope is shown as 1.0V to 2.0H. A clay zone in the dam constitutes the major portion of the upstream slope. The downstream edge of the crest of the clay embankment is located 8 feet back from the downstream side of the dam crest. The top of the clay zone is at elevation 713 feet. From this elevation the clay zone slopes downstream at 1.0V to 1.0H from the centerline. The remainder of the dam is shown as earth with no reference to specific material type. A reinforced concrete core wall is shown along a vertical through the downstream edge of the crest of the clay embankment between stations 2+15 and 5+13. The elevation of the top of the core wall is at 695.89 feet. A core trench is shown along the entire length of the dam. Stone facing is shown along the upstream slope to a thickness of 12 to 18 inches.

The spillway was not constructed according to the design drawings but rather parallel to the main axis of the dam. The spillway consists of a 50.25 foot wide reinforced concrete rectangular weir on the left abutment. The spillway crest is assumed to be at elevation 713 feet. The spillway channel is constructed of stone and mortar. The channel undergoes a transition from a rectangular section at the discharge apron to a 50 foot wide trapezoidal section with 1.0V to 1.0H side slopes farther downstream.

A pumphouse is located immediately downstream of the dam. The intake structure is a 9 foot square reinforced concrete tower with three 6-inch diameter intakes. The first is located 8 feet below the normal water surface elevation, the next 16 feet below normal pool, and the last 23 feet below normal pool. A 6-inch diameter cast iron pipe, approximately 280 feet long, connects the intake structure with the pump house. The pumphouse is equipped with two pumps. One is mounted vertically and the other is mounted horizontally. The vertically mounted pump normally operates continuously. At the time of the inspection, the horizontally mounted centrifugal pump was not in service and was awaiting repairs.

Available drawings show a 14-inch diameter cast iron pipe approximately 300 feet long which serves as a low level outlet. The pipe is located at station 4+09 along the dam axis. The visual inspection, however, revealed a 9-inch diameter pipe rather than the 14-inch pipe indicated on the drawing.

The regional geologic setting of the dam places it on essentially flat-lying rocks. The dam site is on a synclinal fold, which flanks the Lincoln Fold, whose northwesterly trending axis is about six miles to the northeast ("Structural Features Map of Missouri", 1971).

The rocks underlying the site are believed to be from the Cabiness subgroup of the Cherokee Group (Pennsylvanian) (Geologic Map of Missouri, 1979). These beds are cyclic deposits of predominately sandstone and shale (Claystone) with some associated coal beds. No known outcrops exist in the vicinity of the dam site. Plate 9 is a portion of the Geologic Map of Missouri showing the damsite.

The area around the dam is characterized by relatively flat uplands which are quite deeply dissected by the streams crossing the area.

b. Location

The Monroe City South Lake Dam is located off of Little Indian Creek in Monroe County, Missouri. A location map of the dam is presented as Plate 1, page P-2. The location of the dam is also shown on the drainage basin map, Plate 1 in Appendix B. There are no downstream communities between the dam and where Little Indian Creek discharges into the Salt River. The dam and lake are shown on the Joanna, Missouri Quadrangle Sheet (7.5 Minute Series) in Section 30, Township 56 North, Range 7 West.

c. Size Classification

According to the "Recommended Guidelines for Safety Inspection of Dams", by the U.S. Department of the Army, Office of the Chief Engineer, the dam is classified in the dam size category as being "Small" since its storage is less than 1,000 acre-feet. The dam is also classified as "Small" in dam height category because its height is less than 40 feet. The overall size classification is, accordingly, "Small" in size.

d. Hazard Classification

The dam has been classified as having "High" hazard potential in the National Inventory of Dams, on the basis that in the event of failure of the dam or its appurtenances, excessive damage could occur to downstream property, together with the possibility of the loss of life. Our findings concur with this classification. The estimated damage zone extends two miles downstream of the dam. U.S. Highway 24 crosses the estimated damage zone twice within one mile and a dwelling lies two miles downstream of the dam. One pumphouse is located immediately downstream of the dam.

e. Ownership

The Monroe City South Lake Dam is owned by the City of Monroe, c/o Mr. Jack Little, Water Superintendent, 300 North Main Street, Monroe City, Missouri, 63456.

f. Purpose of Dam

The purpose of the dam is to impound water for use as a domestic water supply. The reservoir is also used for recreation.

g. Design and Construction History

The Monroe City South Lake Dam was designed by W.B. Rollins & Company, Consulting Engineers, of Kansas City, and constructed in 1937. According to the current Water Superintendent, Mr. Jack Little, the design and construction was done as a W.P.A. project. A set of plans is available from the Office of the Water Superintendent.

h. Normal Operational Procedures

Normal operational procedure is to allow the lake to remain as full as possible at all times with the water level being controlled by rainfall, runoff, evaporation, seepage and the elevation of the spillway crest. At this time the reservoir is being used for water supply to the City of Monroe.

1.3 Pertinent Data

a. Drainage Area (square miles): 1.04

b. Discharge at Damsite

Estimated experienced maximum flood (cfs): 50 cfs

Estimated ungated spillway capacity with
reservoir at top of dam elevation (cfs): 867 cfs

c. Elevation (feet above MSL)

Top of dam: 716.0

Spillway crest: 713.0

Normal Pool 713.0

Maximum Pool(PMF): 717.73

d. Reservoir

Length of pool with water surface at
top of dam elevation (feet): 3300.0

Length of normal pool (feet): 3200.0

e. Storage (acre-feet)

Top of dam: 400

Spillway crest: 217

Normal Pool: 217

Maximum Pool (PMF): 564

f. Reservoir Surface (acres)

Top of dam: 73

Spillway crest: 50

Normal Pool: 50

Maximum Pool(PMF): 92+

g. Dam

Type:	Zoned Earthfill
Length:	972 feet
Structural Height:	31 feet
Hydraulic Height:	31 feet
Top width:	12 feet
Side slopes:	
Downstream	1V to 2H
Upstream	1V to 2.5H
Zoning:	Two - clay core and downstream shell
Impervious core:	Upstream clay zone and a concrete core wall
Cutoff:	Core trench with variable bottom width, 4 feet in depth and vertical walls
Grout curtain:	Unknown

h. Diversion and Regulating Tunnel None

i. Spillway

Type:	Rectangular weir, uncontrolled
Length of weir:	50.25 feet
Crest Elevation (feet above MSL):	713.0

j. Regulating Outlets

Type:	6-inch cast iron water supply pipe
Length:	280 feet (according to plans)
Closure:	Gate Valve
Maximum Capacity:	Unknown

Type: 9-inch cast iron low level by-pass pipe
Length: 300 feet (according to plans)
Closure: Unknown
Maximum Capacity: Unknown

SECTION 2 : ENGINEERING DATA

2.1 Design

A six page set of design drawings for the Monroe City South Lake Dam is available from the water superintendent for the City of Monroe. The drawings were prepared in 1937 by W.B. Rollins & Co., Engineers, and appear as plates in this report. No specifications for the project were available.

2.2 Construction

According to Mr. Little the dam was constructed in 1937 as a W.P.A. Project. No construction records or as built drawings were available. The source of the embankment materials is unknown, however, it is probable that soils within the immediate area of the dam were used.

2.3 Operation

No operation records are available for the Monroe City South Lake Dam.

a. Availability

The availability of engineering data is poor and consists only of the six drawings mentioned in Section 2.1, State Geological Maps and U.S.G.S. Quadrangle Sheets. No information on subsurface investigations or soil testing was available. No information on design hydrology or hydraulic design was available, nor were seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams", which is considered a deficiency.

b. Adequacy

The conclusions presented in this report are based on field measurements, the available engineering data, past performance and present condition of the dam. The data available is adequate to evaluate the hydraulic and the hydrologic capabilities of the dam.

Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions and made a matter of record.

c. Validity

The slopes, height, crest width, discharge channel, intake structure and pump house appear to be in agreement with the available drawings. The alignment on the left side of the dam and the spillway, however, were not constructed as shown on the drawings. All elevations appearing on the drawings appear to be referenced to an arbitrary datum. The low level outlet, shown on the drawing to be a 14-inch diameter pipe was actually measured at 9-inches in diameter.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

A visual inspection of the Monroe City South Lake Dam was made on June 12, 1979. The following persons were present during the inspection:

Name	Affiliation	Disciplines
David J. Kerkes	Engineering Consultants, Inc.	Soils
Peter Howard	Engineering Consultants, Inc.	Geology
Mark R. Haynes	Engineering Consultants, Inc.	Civil, Mechanical & Structural
Kenneth L. Bullard	Engineering Consultants, Inc.	Hydraulics & Hydrology
Kevin J. Blume	Consoer, Townsend & Assoc., Ltd.	Civil and Structural
Jack Little	City of Monroe	Water Superintendent

Specific observations are discussed below.

b. Dam

The crest of the dam had a well maintained cover of grass. No trees were growing along the crest. There was no evidence of significant settlement or cracks on the crest. No significant deviations in horizontal or vertical alignment were apparent. Material exposed immediately below the vegetation cover on the embankment appeared to be clayey silt to fine sand. According to Mr. Little, the dam has never been overtopped.

The upstream slope was only partially visible for inspection owing to the reservoir level. Considerable brush is growing along the top of the slope. While the slope is protected by riprap, the riprap does not extend to the crest and erosion has occurred immediately above the protection. There were no readily apparent signs of past or present distress in the upstream slope.

The downstream slope had a well maintained cover of grass with no signs of erosion. There were no trees or bushes growing on the slope. A small depression was apparent in one area about 268 feet from the right abutment. The area was about 12 feet wide and extended about half way up the embankment from the toe. The depression is apparently the result of a shallow slide which, judging from the grass cover, did not occur in the recent past. There were no other indications of past or present slope instability. There were no cracks observed in the downstream slope. No seepage was observed along the downstream toe. Field measurements of the slope are, for the most part, in agreement with available drawings.

Both the left and right abutments were at approximately the same elevation as the crest of the dam. Both abutments appeared to be natural earth material with good grass protection. No erosion or cracking was observed in either abutment along the embankment contact. No seepage was observed in or around either abutment. No evidence of slope movement was apparent in either abutment. There were no readily apparent signs of damage to either the embankment or abutments due to burrowing animals at the time of the inspection. We were informed by Mr. Little that attempts are made to control burrowing animals.

c. Appurtenant Structures

(1) Spillway

The spillway has apparently had a concrete cap added to it as evidenced by the condition of the concrete relative to the rest of the spillway. This accounts for the difference between what is shown on the available drawings and field measurements made by the inspection team. The concrete on the downstream side of the weir, immediately below the cap, has undergone severe spalling. Reinforcement is exposed on the right side of the spillway (as viewed looking downstream). Standing water was also observed in this location. Immediately downstream of the weir, on the right wingwall, leaching deposits were observed. Some minor temperature cracks were observed in the spillway cap along with a small amount of spalling on the upstream side. No displacement was observed in construction joints. The concrete wingwalls appeared to be in good condition. The discharge apron has deteriorated severely as a result of cracking and spalling.

(2) Outlet Works

The intake structure of the 6-inch outlet pipe was not accessible at the time of the inspection. It was reported by Mr. Little, however, that all the valves are operable and the pumps are used regularly.

The downstream side of the low level outlet was found to be a 9-inch diameter pipe, not a 14-inch diameter pipe as shown on available drawings.

d. Reservoir Area

The water surface elevation was at 712.5 feet above MSL on the day of inspection.

The slopes along the reservoir rim are gentle with good grass protection. No evidence of past or present instability of the slopes was readily apparent.

e. Downstream Channel

The discharge channel is a 50-foot wide stone and mortar channel with 1.0H to 1.0V side slopes. The channel is obstructed by a heavy growth of vegetation. Seepage was observed emerging in the discharge channel approximately 75 feet downstream of the spillway, however, the amount was minimal and clear.

The visual inspection did not reveal any conditions which were felt to pose an immediate threat to the safety of the structure, however, certain conditions do exist which warrant attention. The following items were observed which could affect the safety of the dam or which will require maintenance within a reasonable period of time.

1. The considerable amount of erosion due to wave action on the upstream slope, if allowed to continue, could jeopardize the structural stability of the dam.
2. The vegetation in the downstream channel of the spillway will reduce the hydraulic efficiency of the channel.
3. The severe deterioration of the concrete in the spillway and discharge apron could jeopardize the structural integrity of the spillway.
4. A small depression on the downstream slope caused by a shallow slide should be repaired.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

Monroe City South Lake Dam was built and is primarily used for water supply. Water levels are checked periodically as are the water supply pumps. The city water superintendent handles most of the operation and maintenance regarding the pumps. There are three inlet levels to the intake tower and these valves are also operated by the water superintendent as he deems necessary. Generally the vertically mounted pump operates continuously and at this time the centrifugal pump is not in service and awaiting repairs.

4.2 Maintenance of Dam

The dam itself is maintained by city workers under the direction of the water superintendent. The city crews keep the grass mowed on the slope and maintain the downstream slope free of trees and brush. There have not been any major repairs done to the dam itself since its original construction.

4.3 Maintenance of Operating Facilities

The operating facilities at the damsite consist of the intake tower and associated valves, the pumphouse which contains a wet well with two pumps, and the low level outlet. All of the facilities are maintained by the water superintendent along with city workers.

According to Mr. Little, all of the intake valves are operable. The horizontally mounted centrifugal pump is not in operation at this time due to needed repairs.

It appears that the low level outlet pipe has not been utilized in a long time. The standpipe which houses the valve for the outlet was filled with rust colored water and it is questionable whether or not this valve is operable.

4.4 Description of Any Warning System in Effect

The inspection team was not informed by the owners' representative of any existing warning system in effect.

4.5 Evaluation

While the crest and downstream slope appear to be adequately maintained, more attention should be given to the erosion occurring along the upstream crest and the vegetation growing in this area. The vegetation growing in the discharge channel should also be controlled. The low level outlet should be maintained operable.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design

The watershed area of Monroe City South Lake Dam upstream from the dam axis consists of approximately 668 acres. The watershed area is mostly farmland with some forested areas. Land gradients in the higher regions of the watershed average roughly 1 percent, and in the lower areas surrounding the reservoir average about 2 percent. The Monroe City South Lake Reservoir is located offstream of Little Indian Creek. At its longest arm the watershed is approximately 0.7 mile long. A drainage map showing the watershed area is presented as Plate 1 in Appendix B.

Evaluation of the hydraulic and hydrologic features of Monroe City South Lake Dam was based on criteria set forth in the Corps of Engineers' "Recommended Guidelines for Safety Inspection of Dams", and additional guidance provided by the St. Louis District of the Corps of Engineers. The Probable Maximum Flood (PMF) was calculated from the Probable Maximum Precipitation (PMP) using the methods outlined in the U.S. Weather Bureau Publication, Hydrometeorological Report No. 33. The probable maximum storm duration was set at 24 hours, and storm rainfall distribution was based on criteria given in EM 1110-2-1411 (Standard Project Storm). The SCS method was used for deriving the unit hydrograph, utilizing the Corps of Engineers' computer program HEC-1 (Dam Safety Version). The

unit hydrograph parameters are presented in Appendix B. The SCS method was also used for determining the loss rate. The hydrologic soil group of the watershed was determined by use of published soil maps. The hydrologic soil group of the watershed and the SCS curve number are presented in Appendix B. The curve number, the unit hydrograph parameters, the PMP index rainfall and the percentages for various durations were directly input to the HEC-1 (Dam Safety Version) computer program to obtain the PMF hydrograph. The computed peak discharges of the PMF and one-half of the PMF are 9,887 cfs and 4,944 cfs respectively.

Both the PMF and one-half of the PMF inflow hydrographs were routed through the reservoir by the Modified Puls Method also utilizing the HEC-1 (Dam Safety Version) computer program. The reservoir was assumed at the spillway crest level at the start of the routing computation. The peak outflow discharges for the PMF and one-half of the PMF are 7,645 and 3,344 cfs respectively. Both the PMF and one-half of the PMF, when routed through the reservoir result in overtopping of the dam.

The stage-outflow relation for the spillway was prepared from field notes and sketches prepared during the field inspection. The reservoir stage-capacity data were based on the U.S.G.S. Joanna and Monroe City, Missouri Quadrangle topographic maps (7.5 minute series). The spillway and overtop rating curve and the reservoir capacity curve are presented as Plates 2 & 3, respectively, in Appendix B.

From the standpoint of dam safety, the hydrologic design of a dam aims at avoiding overtopping. Overtopping is especially dangerous for an earth dam because the downrush of waters over the crest can erode the dam embankment and release all the stored water suddenly into the downstream floodplain. The safe hydrologic design of a dam requires a spillway discharge capability, in combination with an embankment crest height that can handle a very large and exceedingly rare flood without overtopping.

The Corps of Engineers designs its dams to safely pass the Probable Maximum Flood that is estimated could be generated from the upstream watershed. This is the generally accepted criterion for major dams throughout the world, and is the standard for dam safety where overtopping would pose any threat to human life. According to the Corps' criteria, the hydrologic requirement for safety for this dam is the capability to pass from one-half of the Probable Maximum Flood to the Probable Maximum Flood without overtopping.

b. Experience Data

No records of reservoir stage or spillway discharge are maintained for this site. However, according to the representative of the owner, the maximum reservoir level was about 6-inches above the spillway crest.

c. Visual Observations

Observations made of the spillway during the visual inspection are discussed in Section 3.1c(1) and evaluated in Section 3.2.

d. Overtopping Potential

As indicated in Section 5.1a, both the Probable Maximum Flood and one-half of the Probable Maximum Flood, when routed through the reservoir, resulted in overtopping of the dam. The peak outflow discharge for PMF and one-half of the PMF are 7,645 cfs and 3,344 cfs respectively. The PMF overtopped the dam crest by 1.73 feet and one-half of the PMF overtopped the dam crest by 0.81 feet. The total duration of embankment overflow is 5.67 hours during the PMF, and 3.08 hours during one-half of the PMF. The spillway and the reservoir of Monroe City South Lake Dam are capable of accommodating a flood equal to approximately 25 percent of the PMF just before overtopping the dam. The spillway and the reservoir of Monroe City South Lake Dam will accommodate the 100-year flood without overtopping the dam.

The failure of the dam could cause extensive damage to the property downstream of the dam and possible loss of life. The estimated damage zone extends about 2 miles downstream of the dam. Within the damage zone are a pumphouse, one dwelling, and two crossings of U.S. Highway 24.

SECTION 6: STRUCTURAL STABILITY

6.1

Evaluation of Structural Stability

a. Visual Observations

Evidence of a past small shallow slide was apparent in the downstream slope as described in Section 3.1b. The slide does not appear to jeopardize the overall safety of the structure. In the absence of seepage and stability analyses, however, no quantitative evaluation of the structural stability can be made. There were no other indications of past or present slope instability.

The crest along the upstream side is undergoing some erosion, however, it does not threaten the safety of the dam at this time.

b. Design and Construction Data

No design computations were uncovered during the report preparation phase. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available. No embankment or foundation soil parameters are available for carrying out a conventional stability analysis on the embankment. No construction data or specifications relating to the degree of embankment compaction are available for use in a stability analysis.

c. Operating Records

No operating records are available relating to the stability of the dam. According to the owner's representative, the embankment has served satisfactorily since it was constructed with no history of problems, to the best of his knowledge.

d. Post Construction Changes

There are no records of post-construction changes, however, it appears that the spillway crest was raised at some point after construction.

e. Seismic Stability

The dam is located in seismic Zone 1, as defined in "Recommended Guidelines For Safety Inspection of Dams" as prepared by the Corps of Engineers, and therefore, does not require a seismic stability analysis.

SECTION 7: ASSESSMENT/REMEDIAL MEASURES

7.1

Dam Assessment

The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

It should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team.

It is also important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that an unsafe condition could be detected.

a. Safety

The spillway capacity of Monroe City South Lake Dam was found to be "Seriously Inadequate". The spillway/reservoir system will accommodate only 25 percent of the PMF without overtopping the dam. However, the spillway/reservoir system can accommodate the 100-year flood without overtopping.

No definitive statement pertaining to the safety of the embankment, based on quantitative information, can be made in view of the absence of seepage and stability analyses for the dam. The present embankment, however, has reportedly performed adequately since its construction without failure or evidence of instability. The dam has reportedly never been overtopped and no evidence was uncovered indicating the contrary.

Some deficiencies were observed which could affect the safety of the dam. These deficiencies are: wave erosion on the upstream slope; heavy vegetation in the downstream channel; the deteriorated concrete in the spillway and discharge apron; and a small depression on the downstream slope as a result of a shallow slide. Remedial actions should be undertaken to correct or control these deficiencies. The lack of seepage and stability analyses on record is also a deficiency which should be corrected.

b. Adequacy of Information

The conclusions presented in this report are based on field measurements, the available engineering data, past performance and present condition of the dam. Information on the design hydrology, hydraulic design, and the operation and maintenance of the dam as well as seepage and stability analyses were not available.

c. Urgency

A program should be developed as soon as possible to monitor, at regular intervals, the deficiencies described in this report. The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. The item recommended in paragraph 7.2a should be pursued on a high

priority basis.

d. Necessity for Phase II Inspection

Based on results of the Phase I inspection, a Phase II inspection is not felt to be necessary.

7.2 Remedial Measures

The remedial measures listed below should be performed under the guidance of an engineer experienced in the design and construction of earthen dams.

a. Alternatives:

Spillway capacity and/or height of the dam should be increased to accommodate the PMF without overtopping the dam. The overtopping depth during the occurrence of the PMF, stated elsewhere in this report is not the required or recommended increase in height of the dam.

b. O & M Procedures:

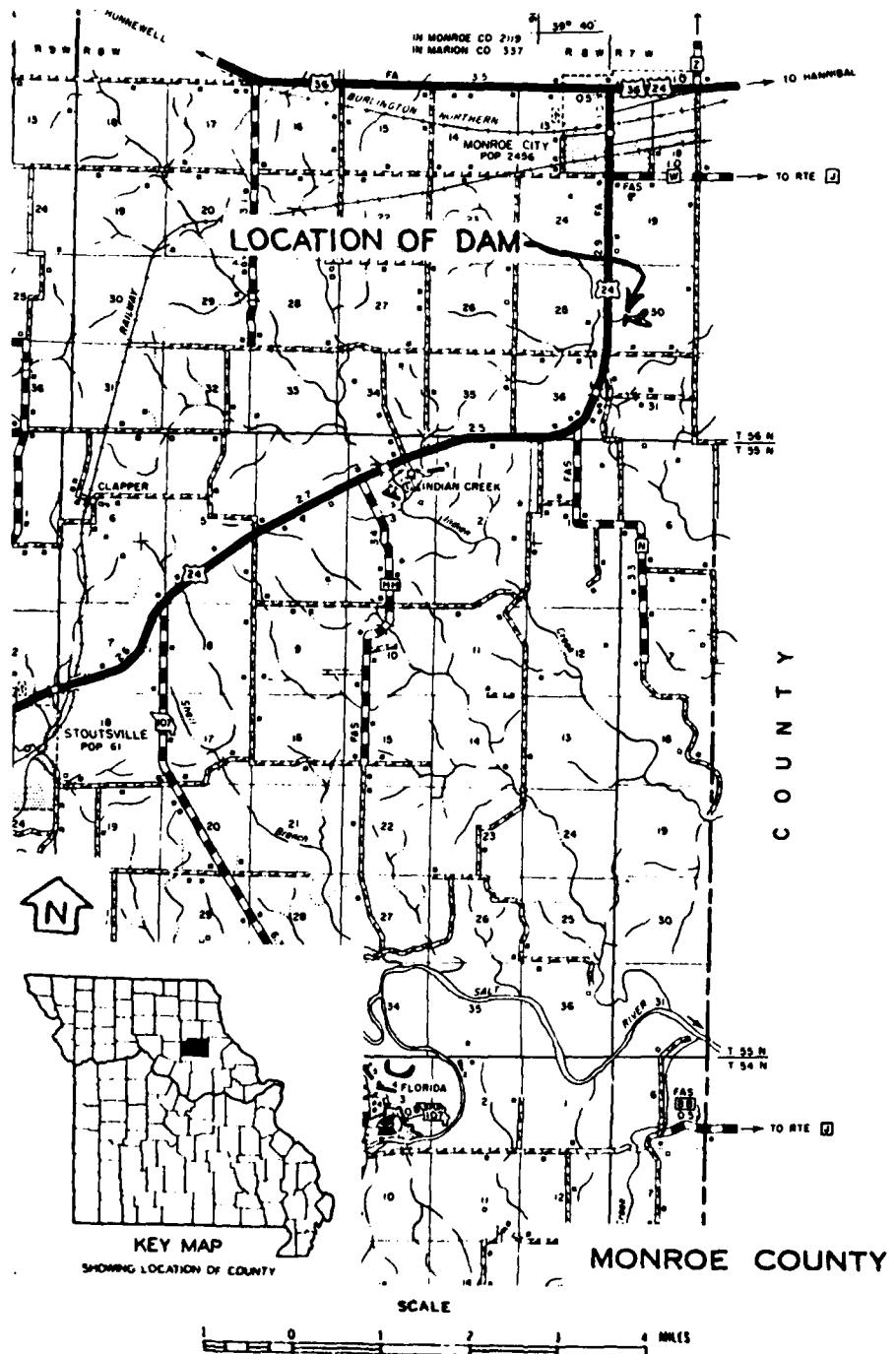
1. Deteriorated concrete should be removed from the spillway and discharge apron and repairs made to the damaged areas.
2. All brush should be cleared from the upstream slope.
3. The erosion along the upstream crest should be repaired and the area should be protected with proper riprap to prevent future erosion.

4. All brush should be cleared from the discharge channel.
5. The 9-inch diameter low level outlet should be restored to an operable condition.
6. Seepage and stability analyses should be performed by a professional engineer experienced in the design and construction of dams.
7. The small depression on the downstream slope caused by a shallow slide should be repaired.
8. The owner should initiate the following programs:
 - (a) Periodic inspection of the dam by a professional engineer experienced in the design and construction of earthen dams.
 - (b) Set up a maintenance schedule and log all visits to the dam for operation, repairs and maintenance.

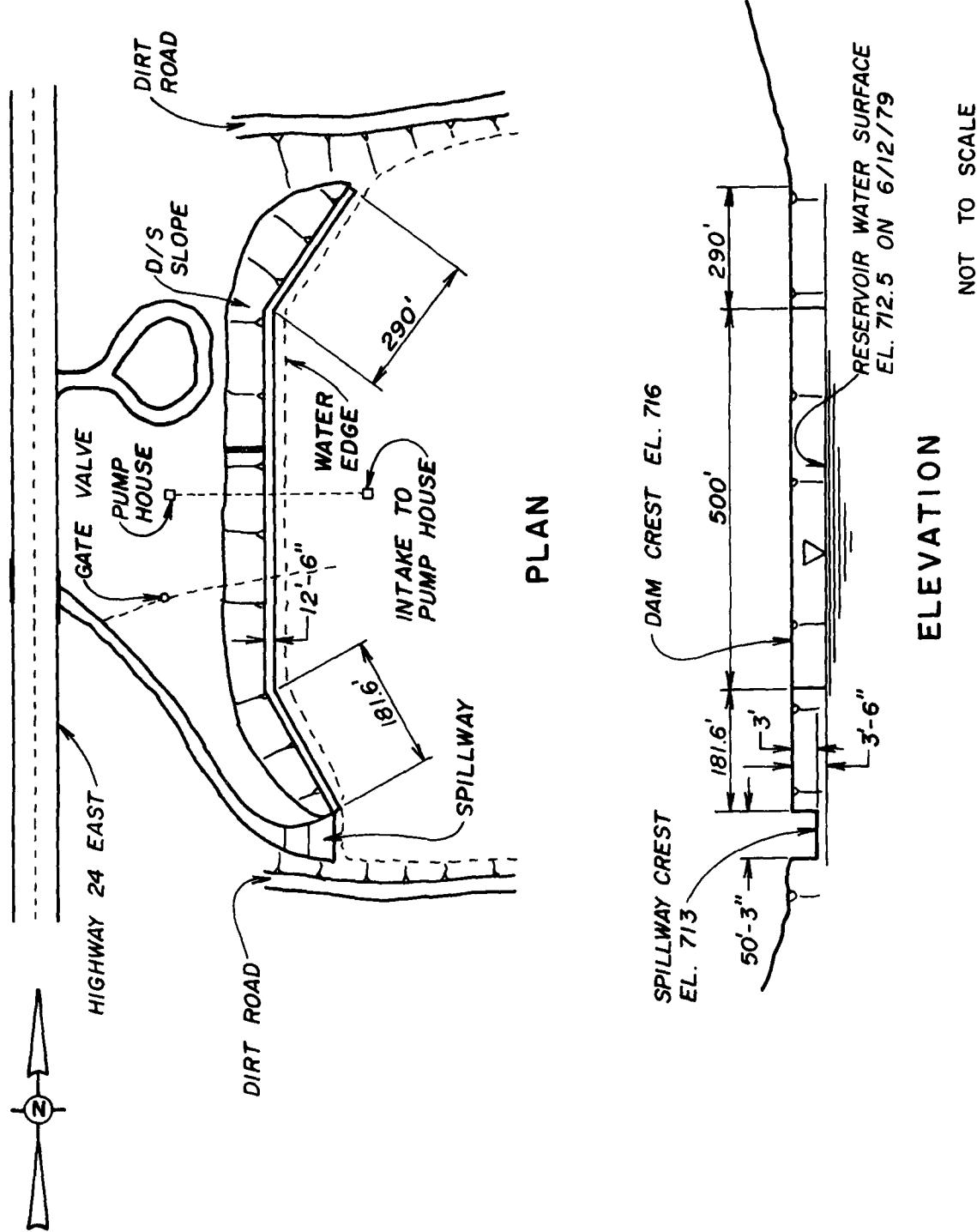
PLATES

P-1

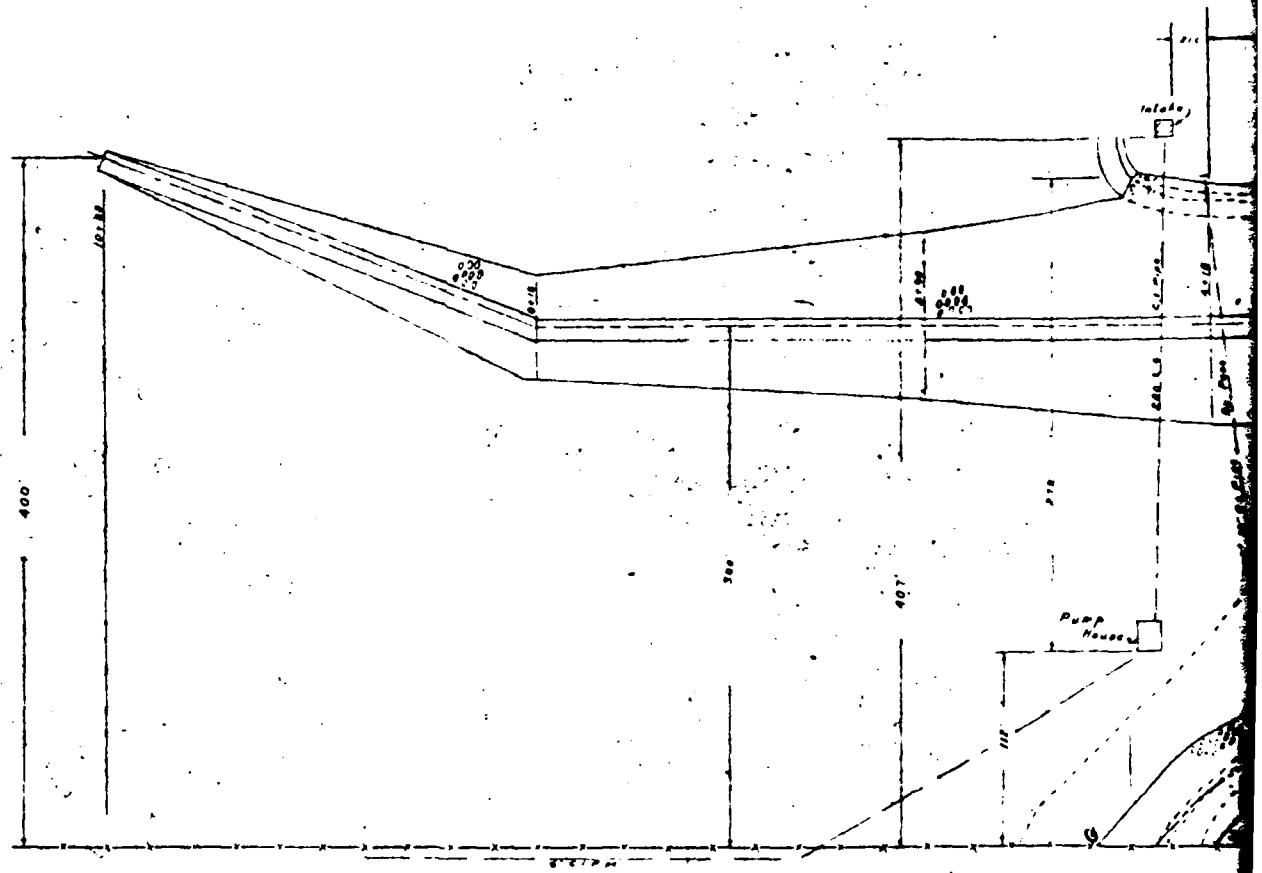
PLATE-I



LOCATION MAP - MONROE CITY SOUTH LAKE DAM



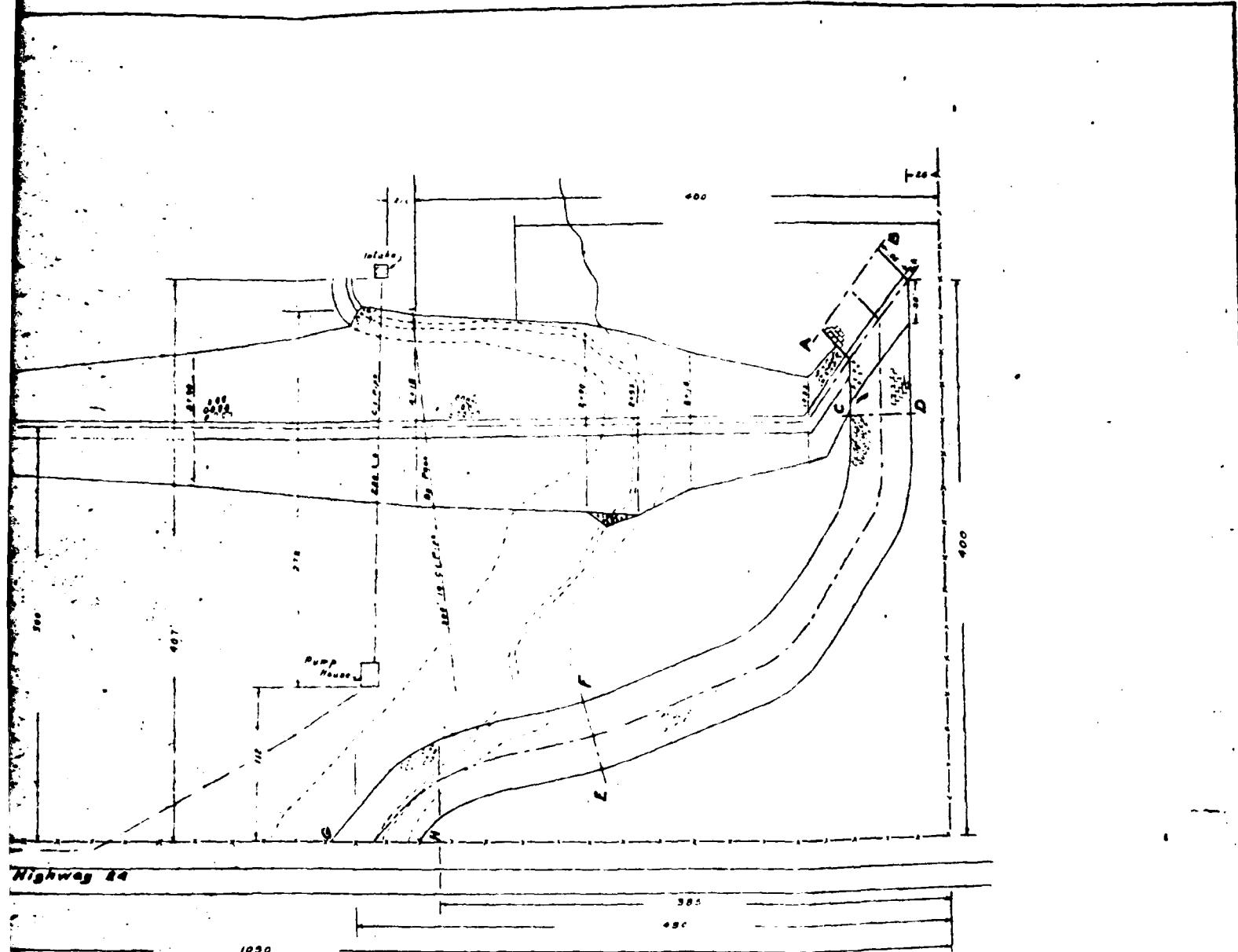
MONROE CITY SOUTH LAKE DAM (MO. 10538)
PLAN & ELEVATION



U.S. Highway 20

1050

Scale 1:50,000

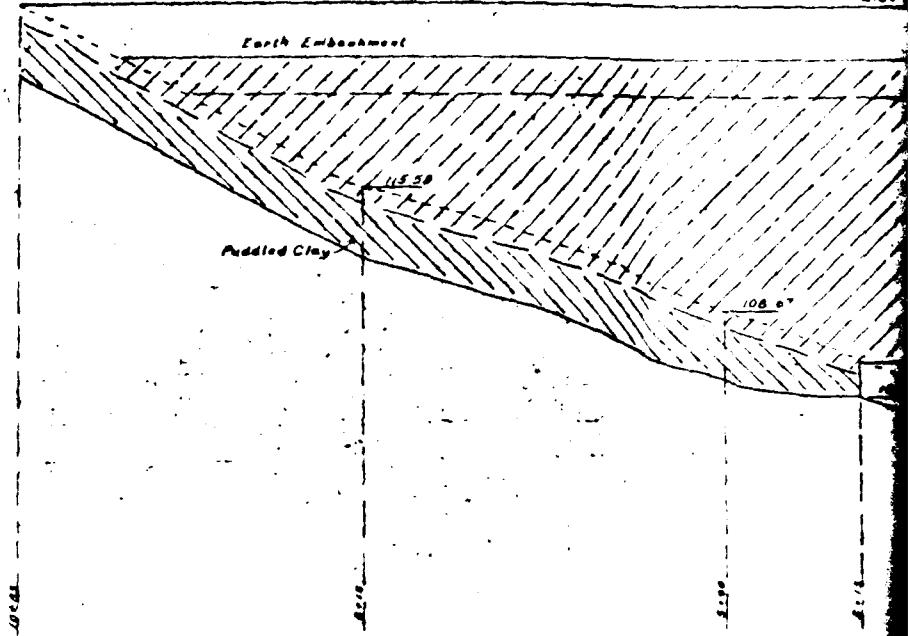


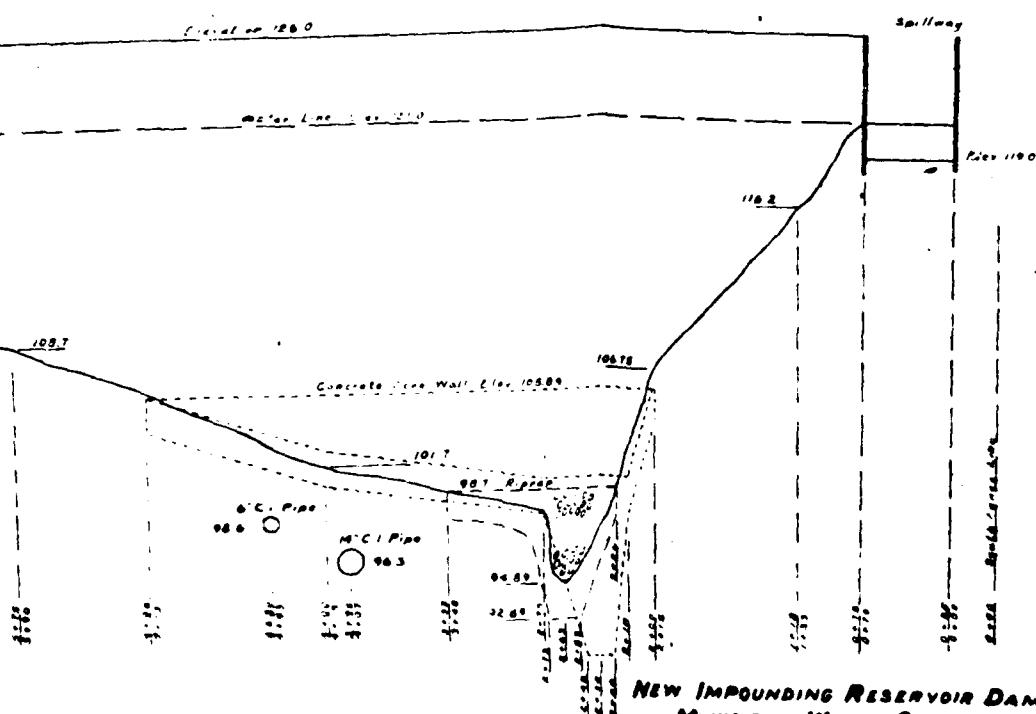
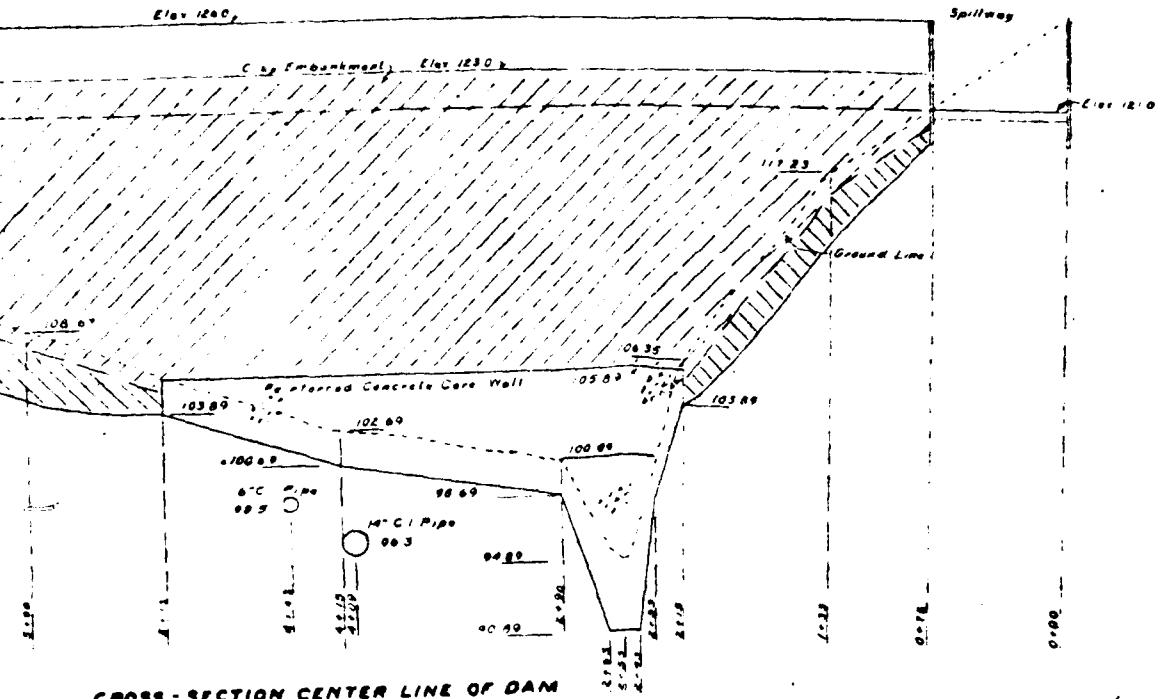
2000 11-20

NEW IMPOUNDING RESERVOIR DAM
PLAN
MUNICIPAL WATER SYSTEM
MONROE CITY, MO.
W. B. ROLLINS & CO. ENGINEERS
OCTOBER, 1951, KANSAS CITY, MO.

Digitized by srujanika@gmail.com

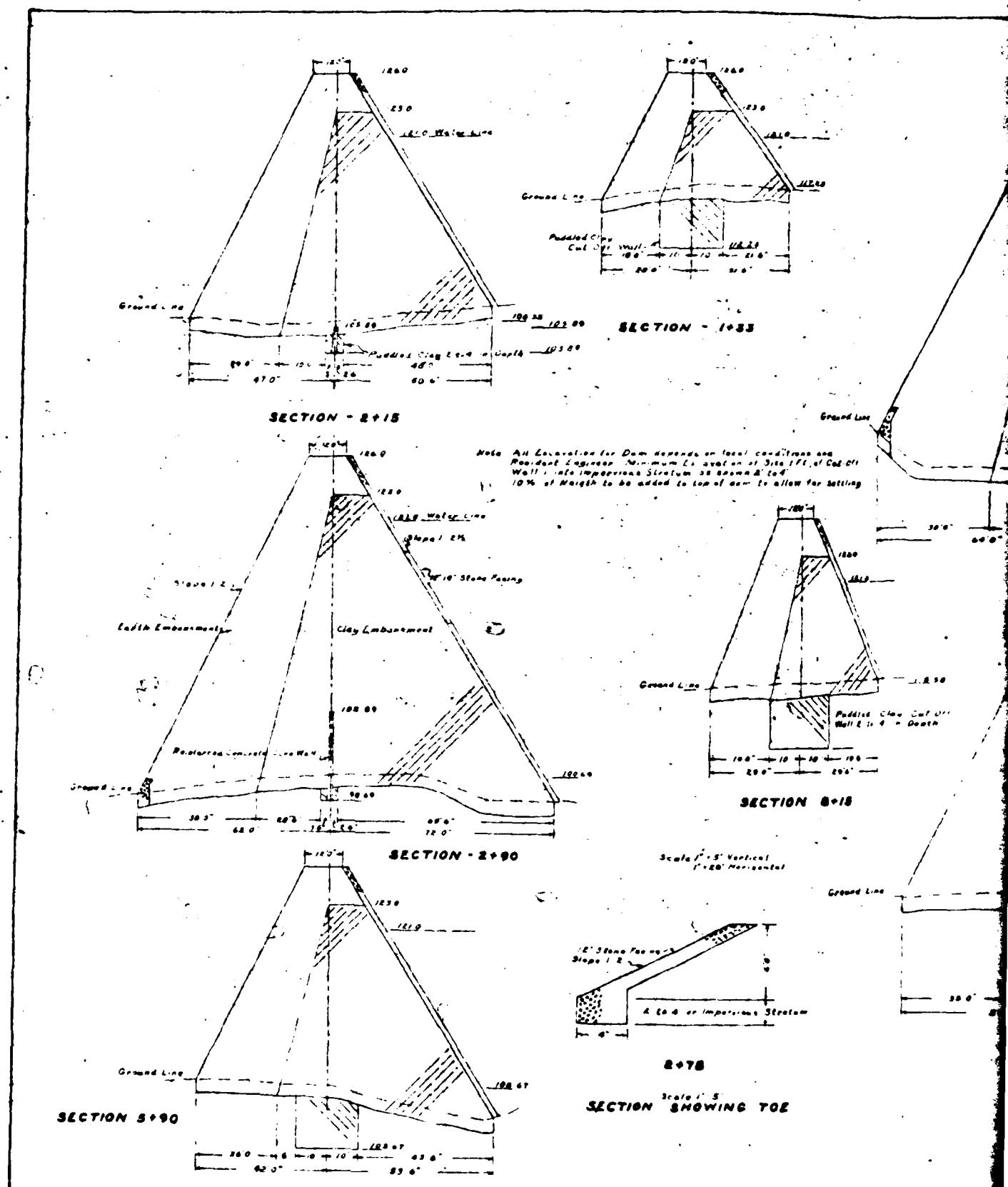
- P-4

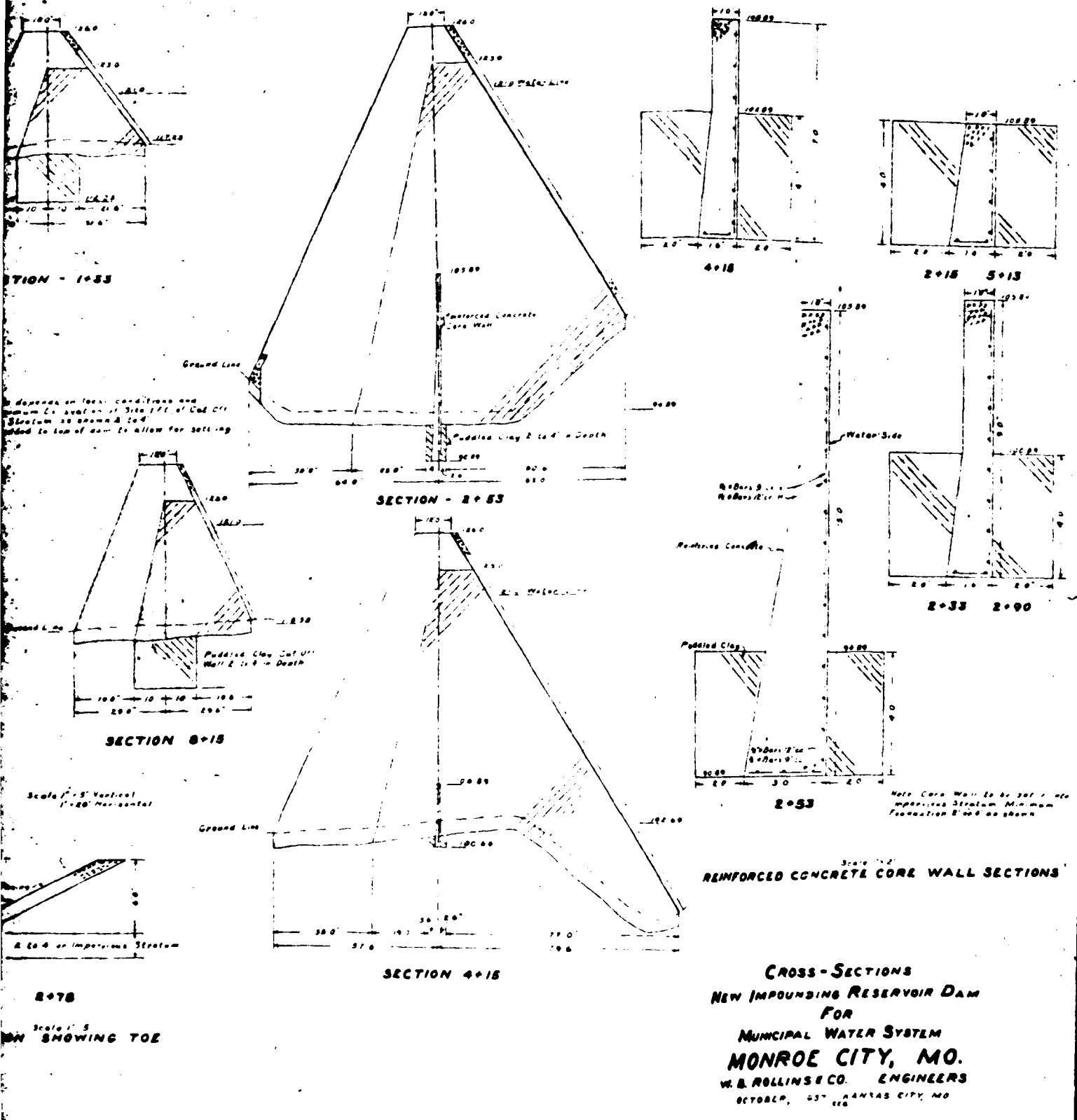




WEST ELEVATION

NEW IMPOUNDING RESERVOIR DAM
MUNICIPAL WATER SYSTEM
MONROE CITY, MO.
W. A. ROLLINS & CO. ENGINEERS
NOVEMBER, 1937 KANSAS CITY, MO





CENTER LINE CROSS-SECTION

G-N

E-F

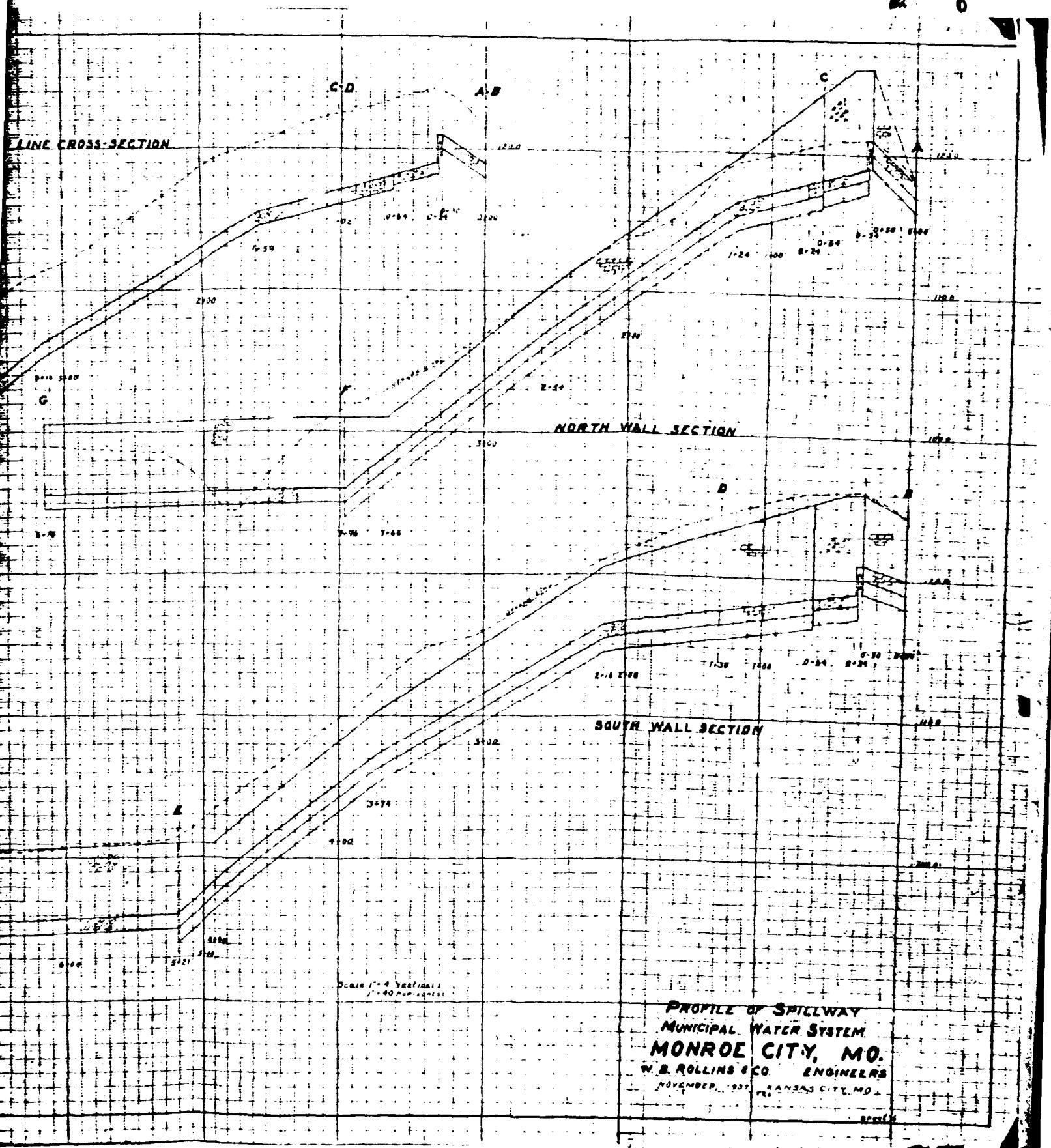
G

PROFILE OF SUCTION LINE

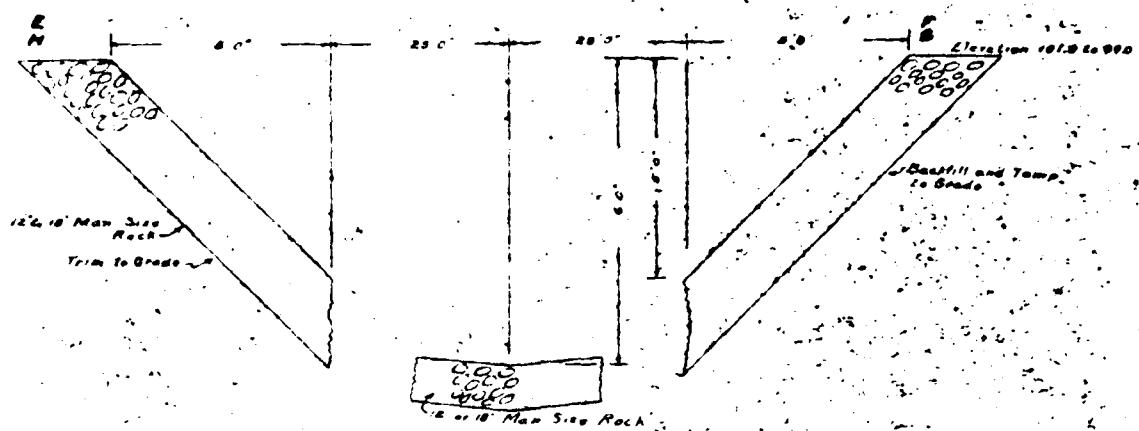
Centerline
Dam

Gate Valve 45 deg
100% C.L. - 100% Blowout

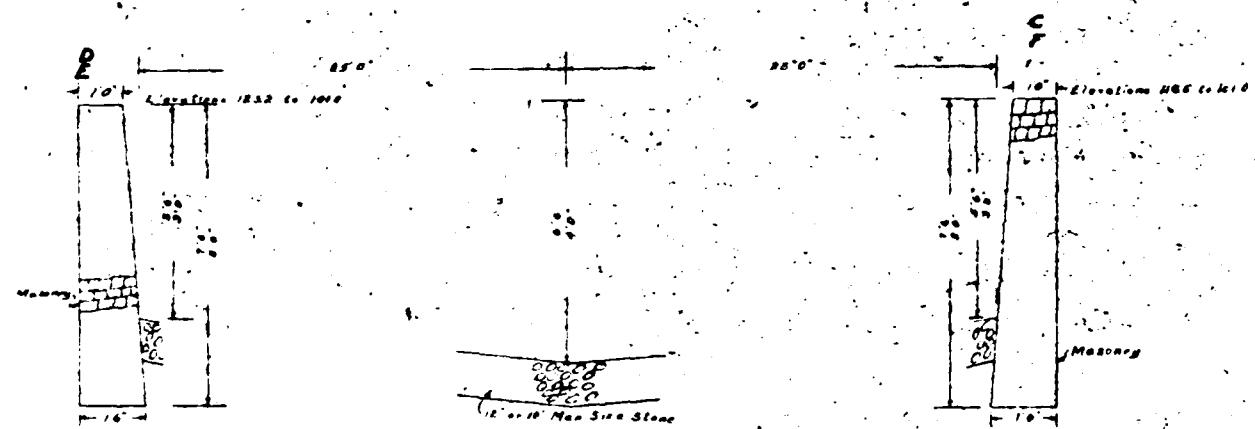
PROFILE OF SUCTION AND
BLOW OUT LINES



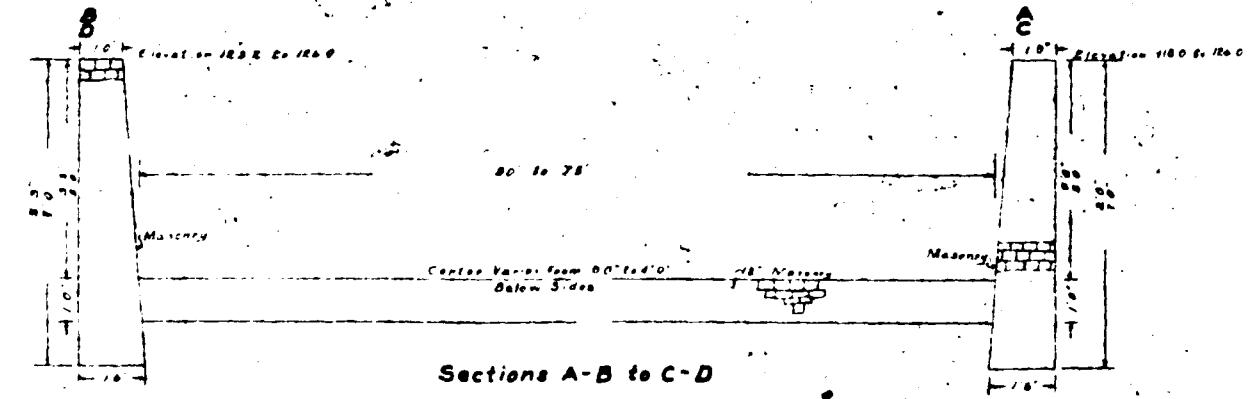
PROFILE OF SPILLWAY
MUNICIPAL WATER SYSTEM
MONROE CITY, MO.
N. B. ROLLINS & CO. ENGINEERS
NOVEMBER, 1937 KANSAS CITY, MO.



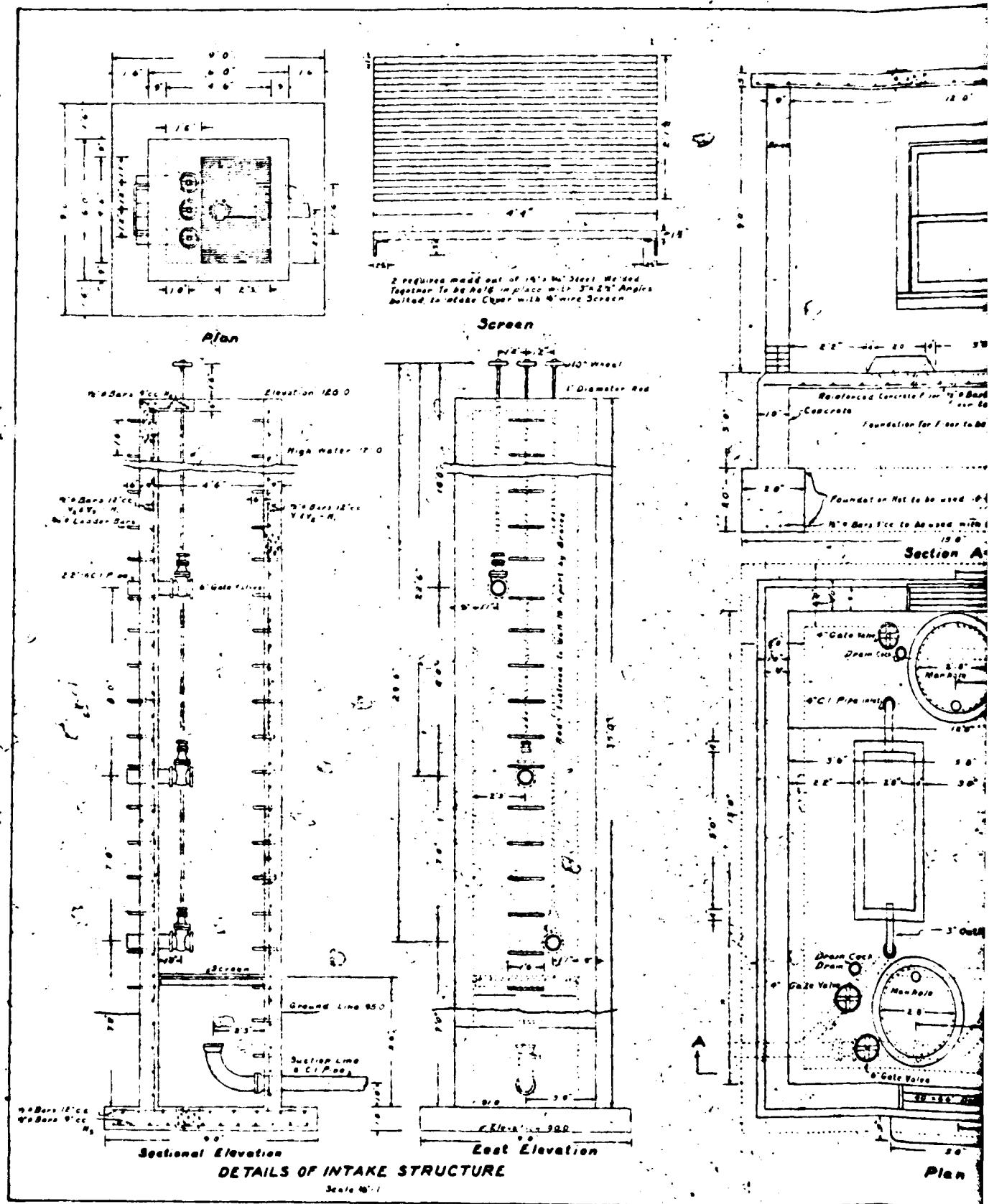
Sections E-F to G-H

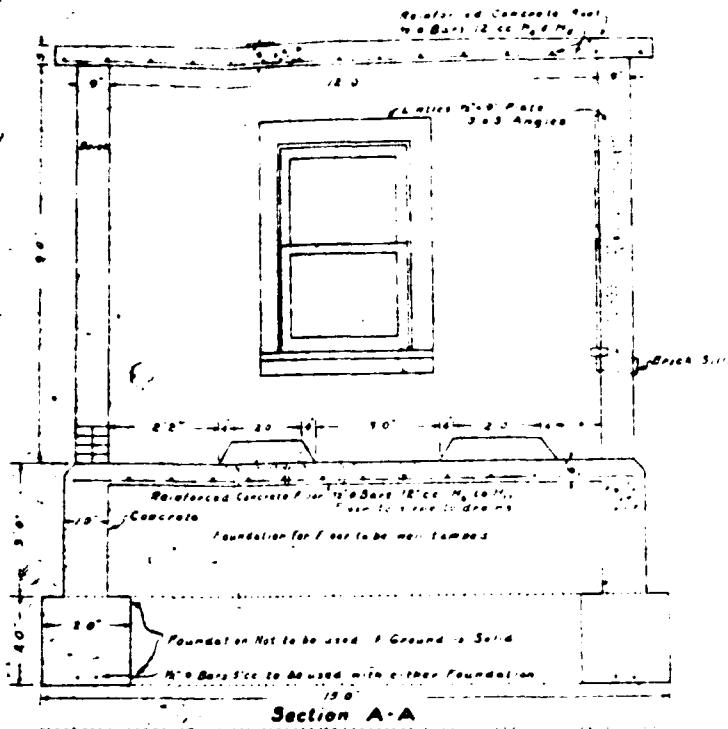


Sections C-D to E-F

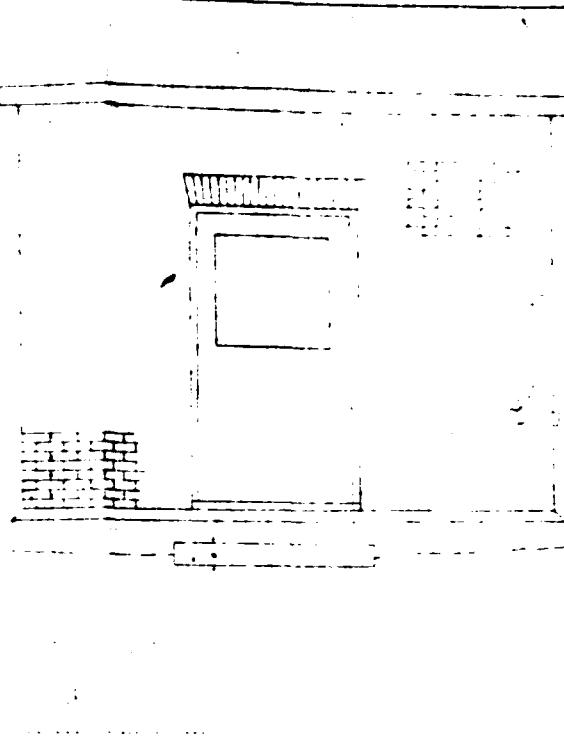


Sections A-B to C-D

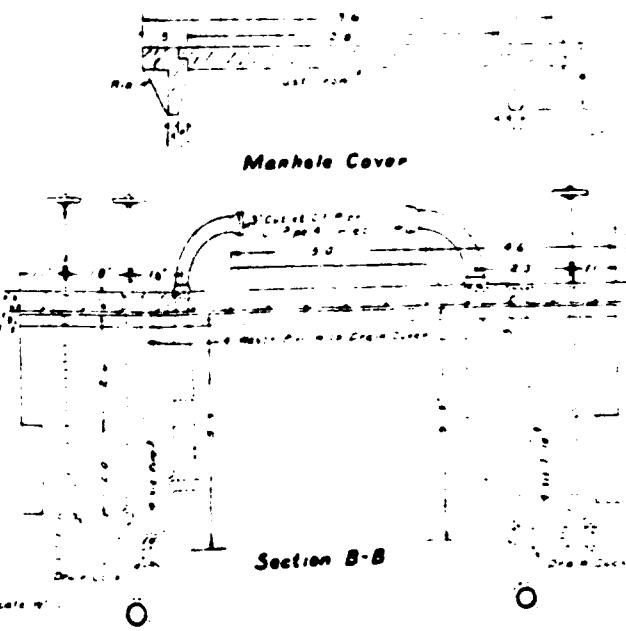




198
Section A-A

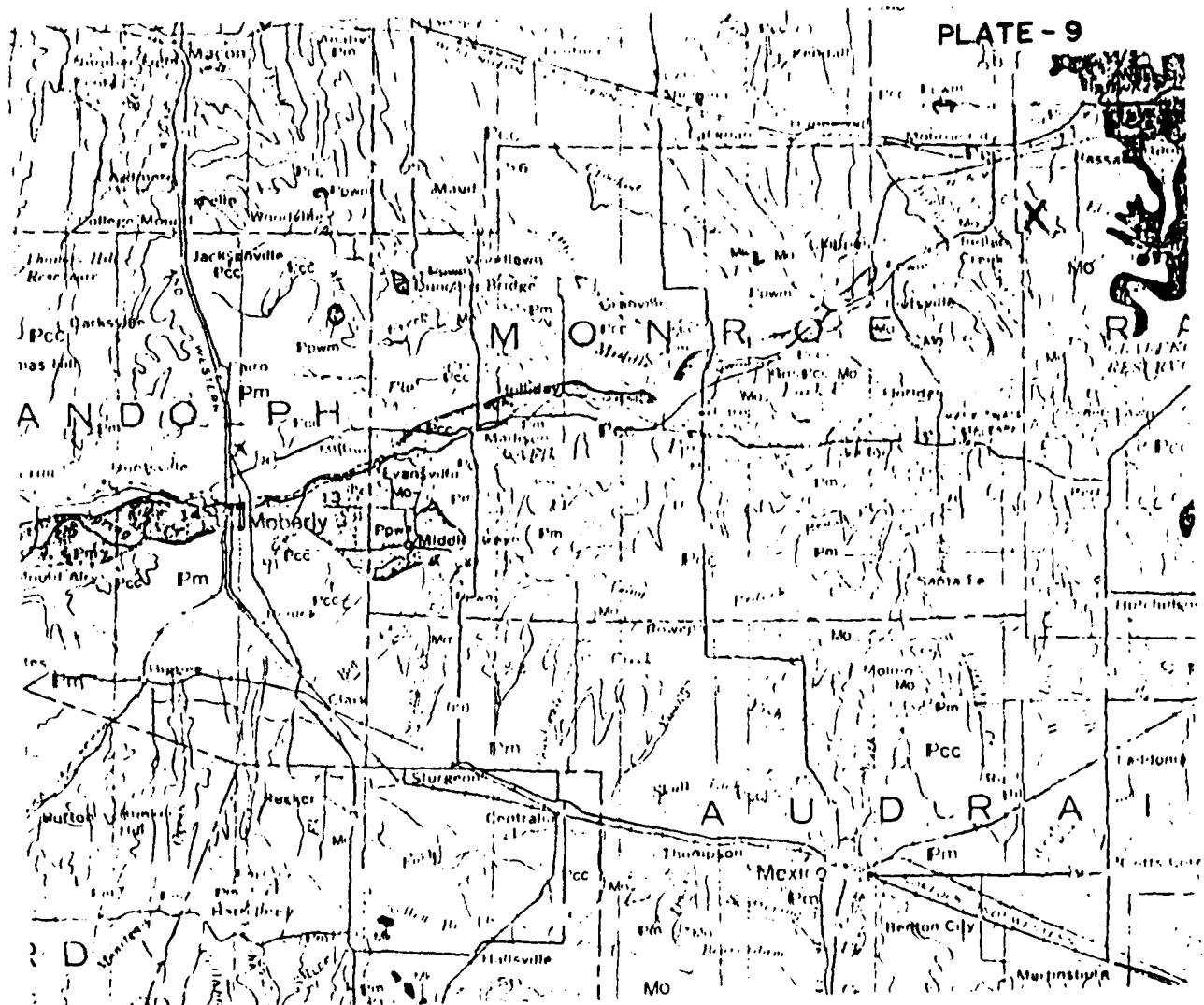


Front Elevation



Section 8-8

PLANS
FOR
MUNICIPAL WATER SYSTEM
MONROE CITY, MO.
W. B. ROLLING & CO. ENGINEERS
OCTOBER, 1937



PENNSYLVANIAN

Rp - PLEASONTON GROUP
 Rpwm - WARRENSBURG - MOBERLY SANDSTONE

Rm - MARMATON GROUP

Rcc - CHEROKEE GROUP

Mm - MERAMACIAN SERIES

MISSISSIPPIAN

Mo - OSAGIAN SERIES

Mk - KINDERHOOKIAN SERIES

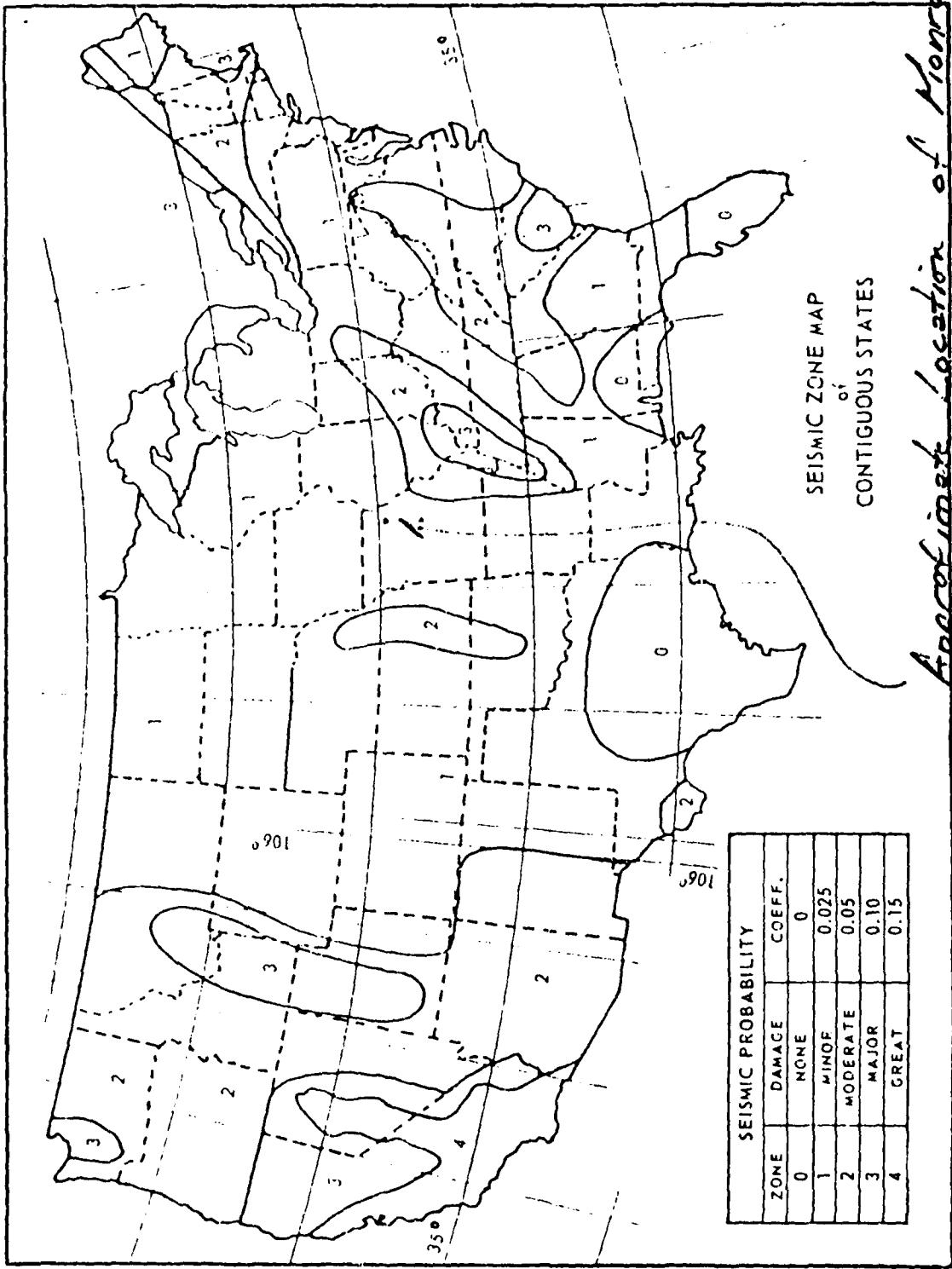
X - LOCATION OF DAM, MO. 10538

REFERENCE:

GEOLOGIC MAP OF MISSOURI,
 MISSOURI GEOLOGIC SURVEY,

a) 1961; b) 1979

Appropriate location of Monroe City
South Lake Dam.



APPENDIX A

PHOTOGRAPHS TAKEN DURING INSPECTION

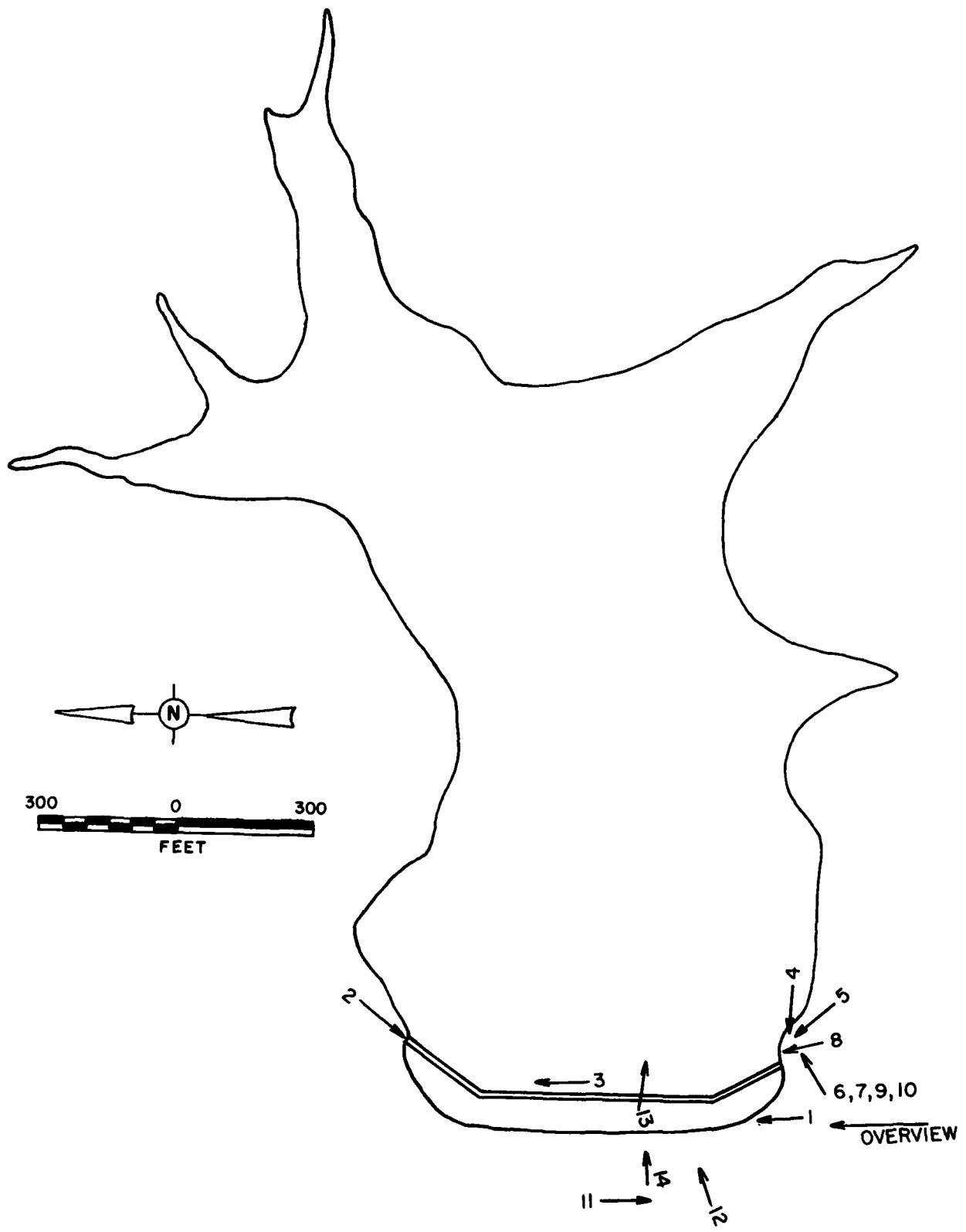


PHOTO INDEX
FOR
MONROE CITY SOUTH LAKE DAM

Monroe City South Lake Dam

- Photo 1. - View of the downstream embankment slope.
- Photo 2. - View of the crest and the upstream embankment slope.
- Photo 3. - View of the upstream embankment slope.
- Photo 4. - View of the approach to the spillway.
- Photo 5. - View of the spillway and the discharge channel. Note leaching of retaining walls and spalling of concrete in the discharge channel.
- Photo 6. - View of the spalling concrete on vertical wall of spillway.
- Photo 7. - View of the spalling concrete, exposed reinforcement and seepage in the spillway.
- Photo 8. - View of the leaching concrete of the retaining walls of the spillway discharge channel.
- Photo 9. - View of the spalling concrete in the discharge channel of the spillway.
- Photo 10. - View of the spillway discharge channel and the spillway.
- Photo 11. - View of the downstream discharge channel to the spillway.
- Photo 12. - View of the outlet to the 9-inch low level outlet pipe.
- Photo 13. - View of the intake control structure and the reservoir rim.
- Photo 14. - View of the pump.

Monroe City South Lake Dam



Photo 1



Photo 2

Monroe City - south of the river



Photo 3



Photo 4

Monroe City, with Lake Pepin



Photo 5

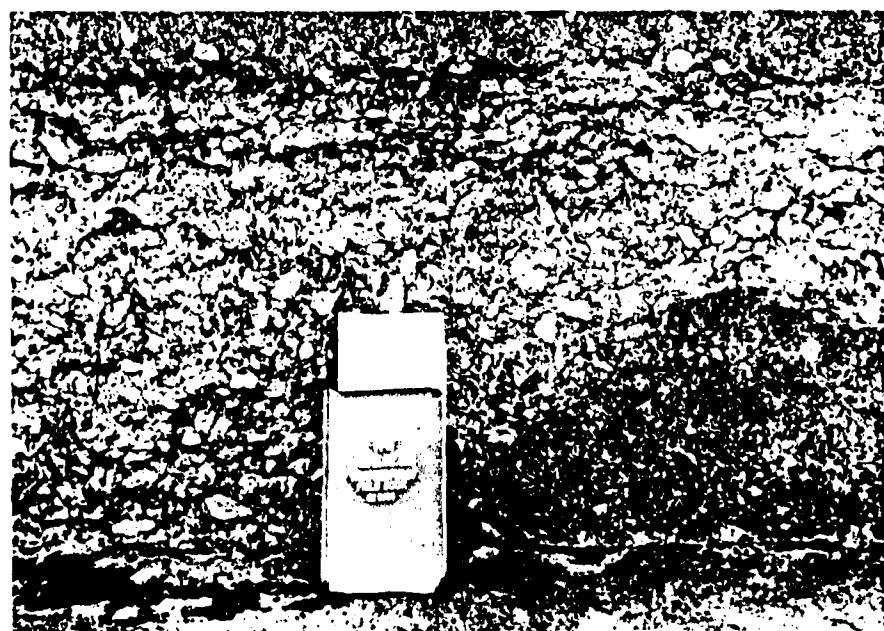


Photo 6

Bottom of the concrete pipe

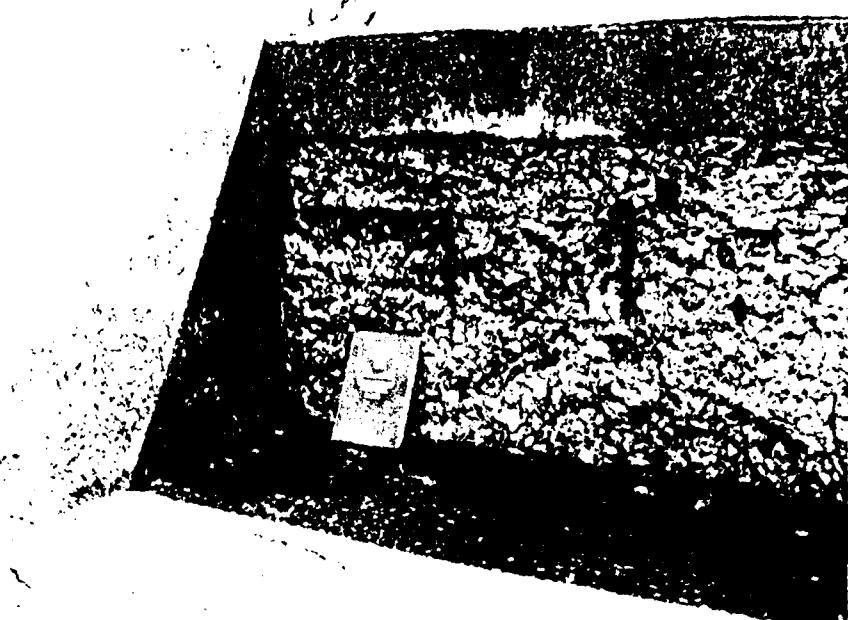


Photo 7

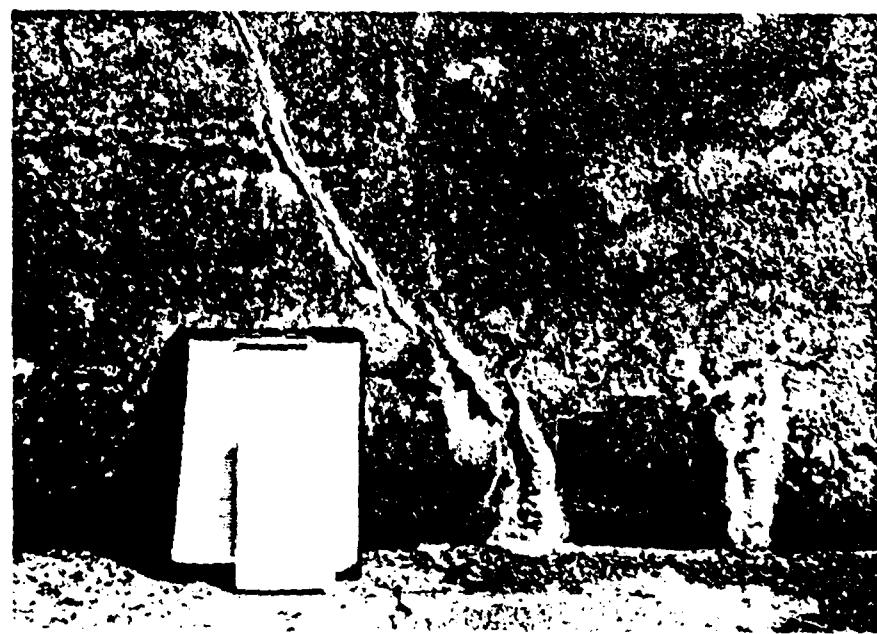


Photo 8

Montrose City South Bank from



Photo 9



Photo 10

Monroe City South Lake Dam



Photo 11



Photo 12

Monroe City South Lake Dam



Photo 13

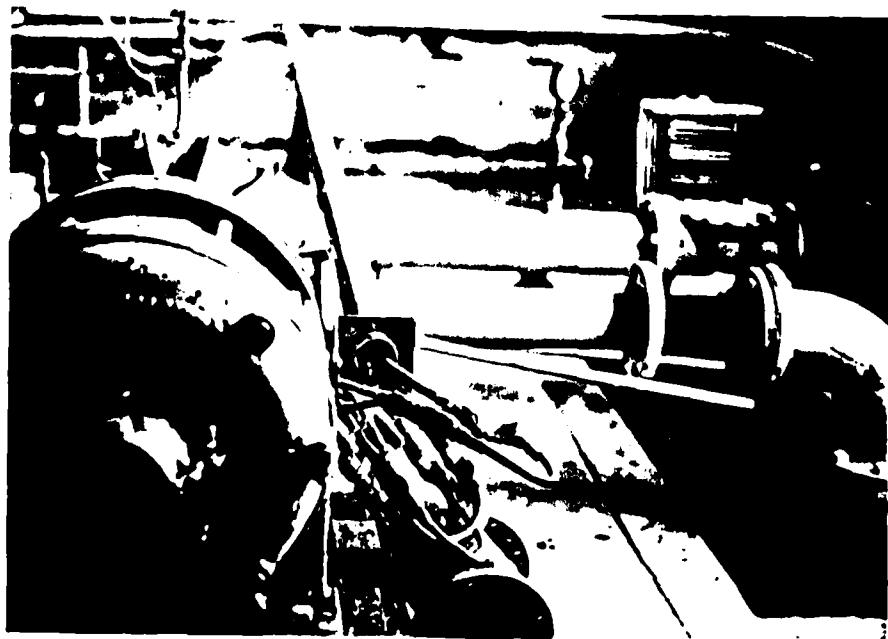
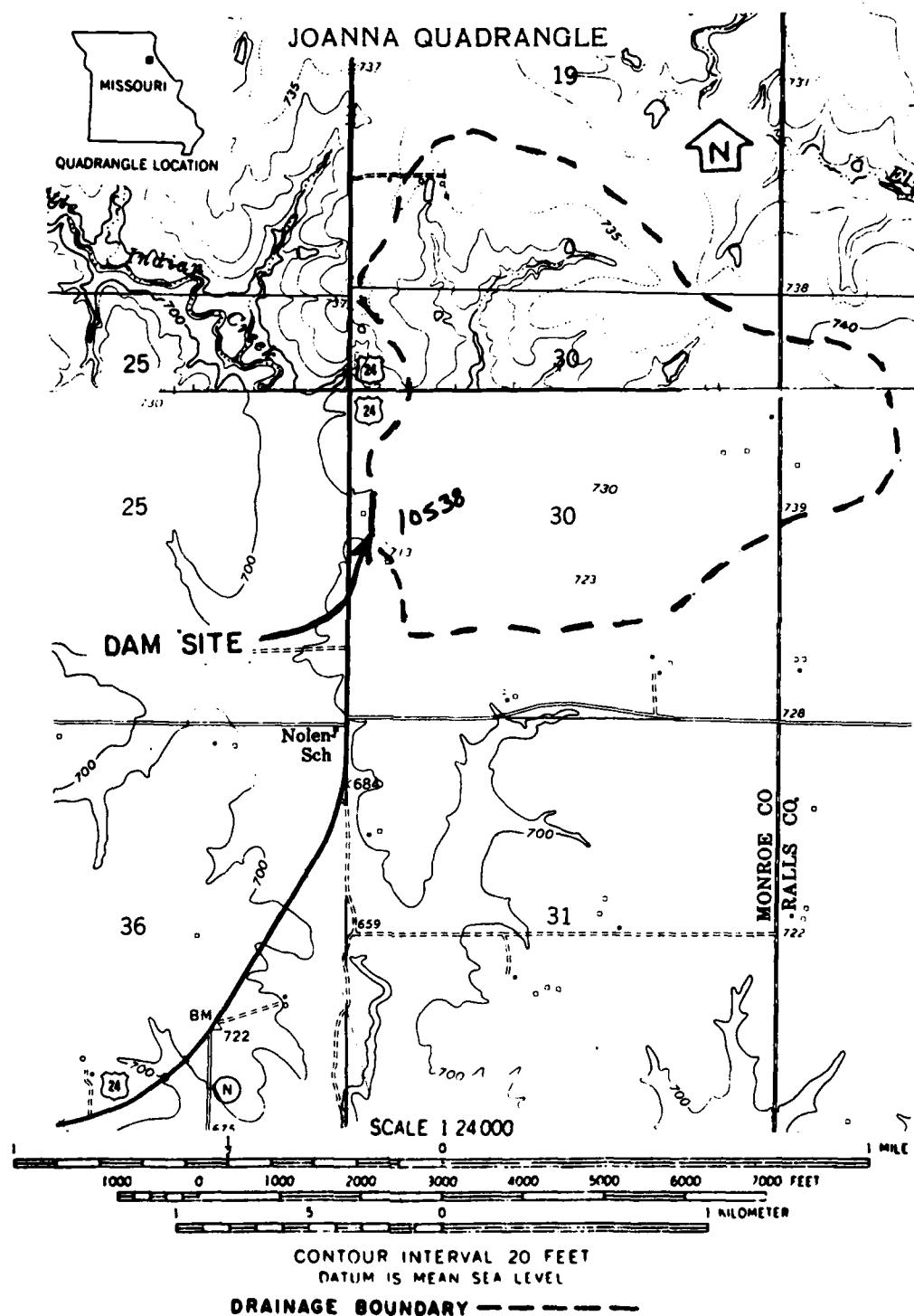


Photo 14

APPENDIX B

HYDROLOGIC COMPUTATIONS

PLATE I, APPENDIX B



MONROE CITY SOUTH LAKE DAM (MO 10538)
DRAINAGE BASIN

Lower Missouri - Missouri
Distance from Lake Dam - # 10538
Spillway and Overtop Rating Curve

SHEET NO. _____ OF _____

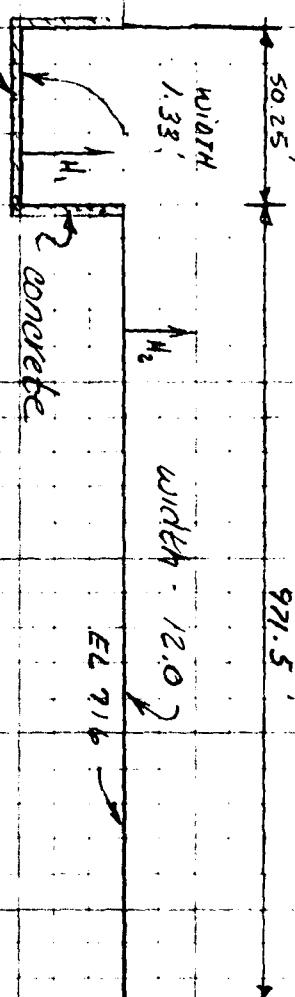
JOB NO. _____

BY dlj

M/B

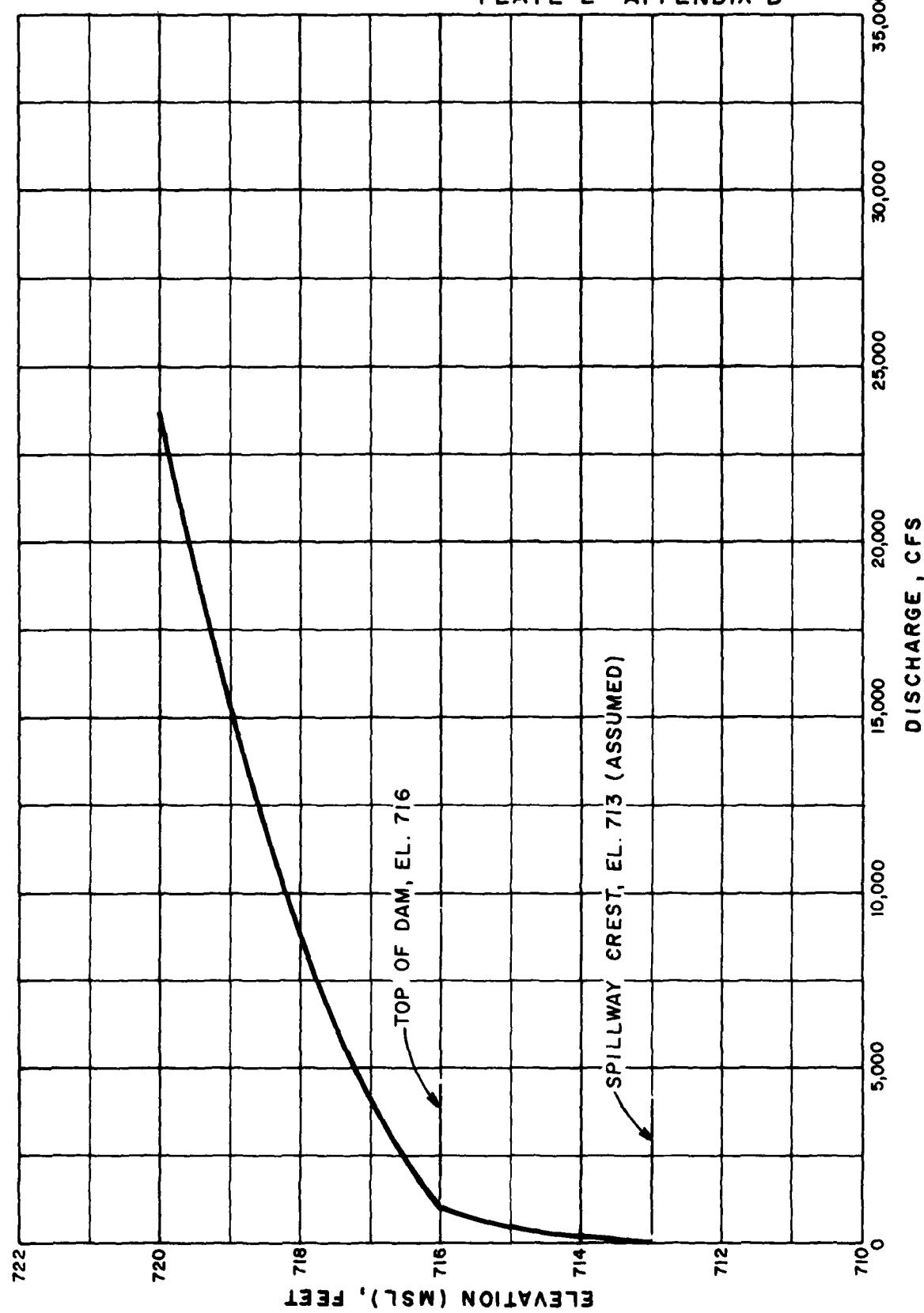
DATE 6/21/77

Reservoir Surface Elev	C_1	H_1	L_1	C_{11} ($C_1, L_1, H_1^{1/2}$)	C_2	L_2	H_2	C_{22} ($C_2, L_2, H_2^{1/2}$)	G_1^2 ($C_1 + C_2$)
713	-	0	50.25'	0	-	97.5	0	0	0
714	2.05	1.0		143			0	0	143
715	3.15	2.0		448			0	0	448
716	3.32	3.0		867			0	0	867
717	4.0			1335			1.0	2574	3909
717.5	4.8			1593			1.5	4730	6323
718	5.0			1865			2.0	7282	9147
720				3090			4.0	26596	23688
725				6935			9.0		
730				1740			14.0		

E 713
(assumed)

B-3

PLATE 2 - APPENDIX B



MONROE CITY S. LAKE DAM (MO. 10538)
SPILLWAY & OVERTOP RATING CURVE

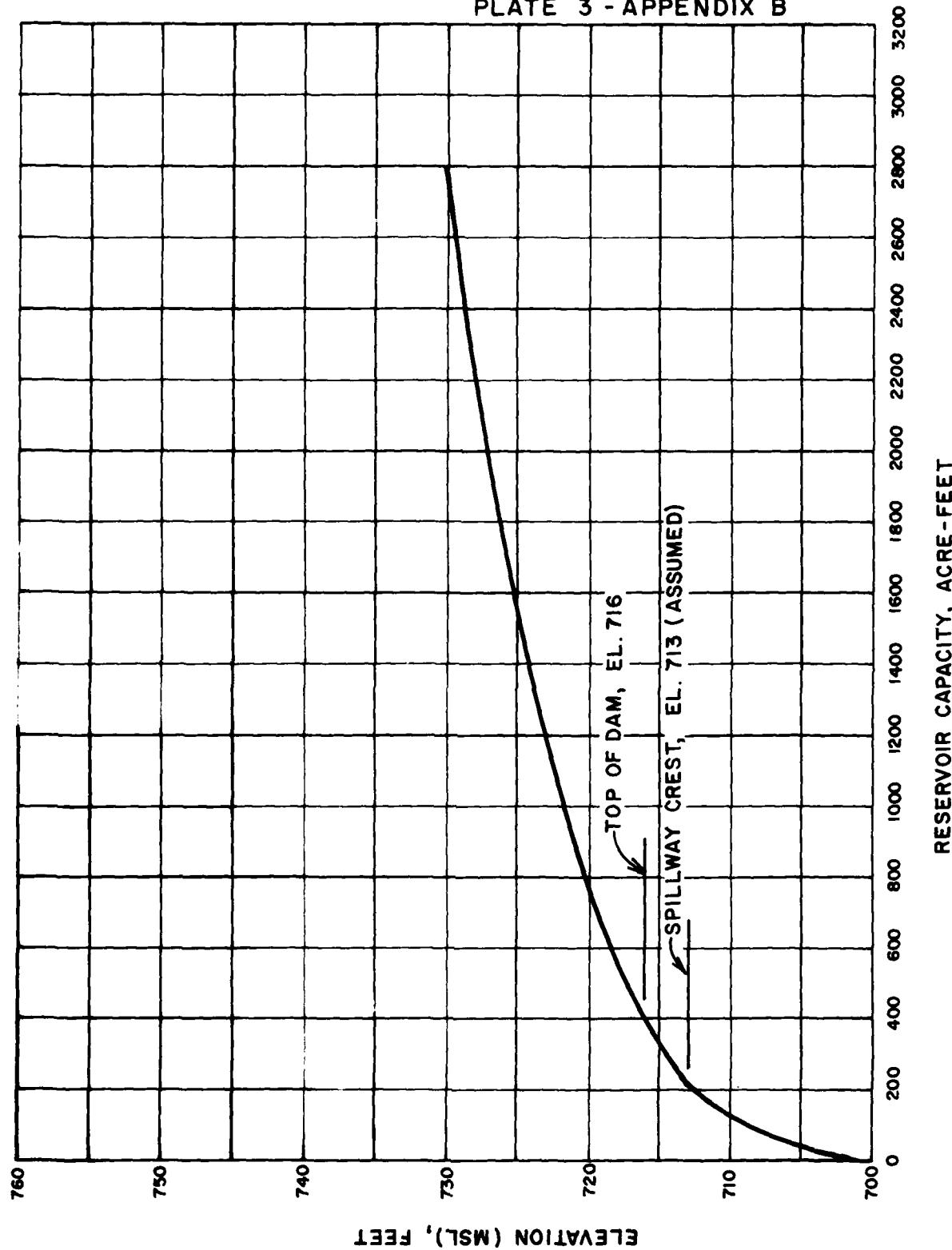
Dom Safety Inspection - Missouri SHEET NO. 1 OF
 MONROE CITY S. LAKE DAM. #10598 JOB NO. 1240
 Reservoir Area Capacity BY M.R.H. DATE 5-18-79
 ONE ✓ ALG ✓

City of Monroe

Reservoir Area Capacity

Elev. M.S.L. (Ft.)	Reservoir Surface Area (Acres)	Incremental Volume (Ac.-ft.)	Total Volume (Ac.-ft.)	Remarks
700	0	0	0	Est. Streambed at Center of Dam.
713	50	217	217	Water Surface as shown on Quadrangle. (ASSUMED STAIRWAY CREST ELEV.)
716	73	183	400	TOP OF DAM ELEV.
720	118	378	778	AREA MEASURED ON USGS MAP.
730	279	1928	2706	AREA MEASURED ON USGS MAP.

PLATE 3 - APPENDIX B



MONROE CITY S. LAKE DAM (MO.10538)
RESERVOIR CAPACITY CURVE

DAM SAFETY INSPECTION - MISSOURI SHEET NO. 1 OF

DAM # MO. 10538 JOB NO. 1240

PROBABLE MAXIMUM PRECIPITATION BY DNZ DATE

HLB 6-22-79 ✓

DAM # MO. 10538

DETERMINATION OF PMP

1. DETERMINE DRAINAGE AREA OF BASIN

D.A. = 668 ACRES

2. DETERMINE PMP INDEX RAINFALL (200 SQ. MI. + 24 HRS. DURATION)

LOCATION OF CENTROID BASIN

LONG = $91^{\circ}43'25''$ LAT. = $39^{\circ}37'31''$ PMP. = 24.3

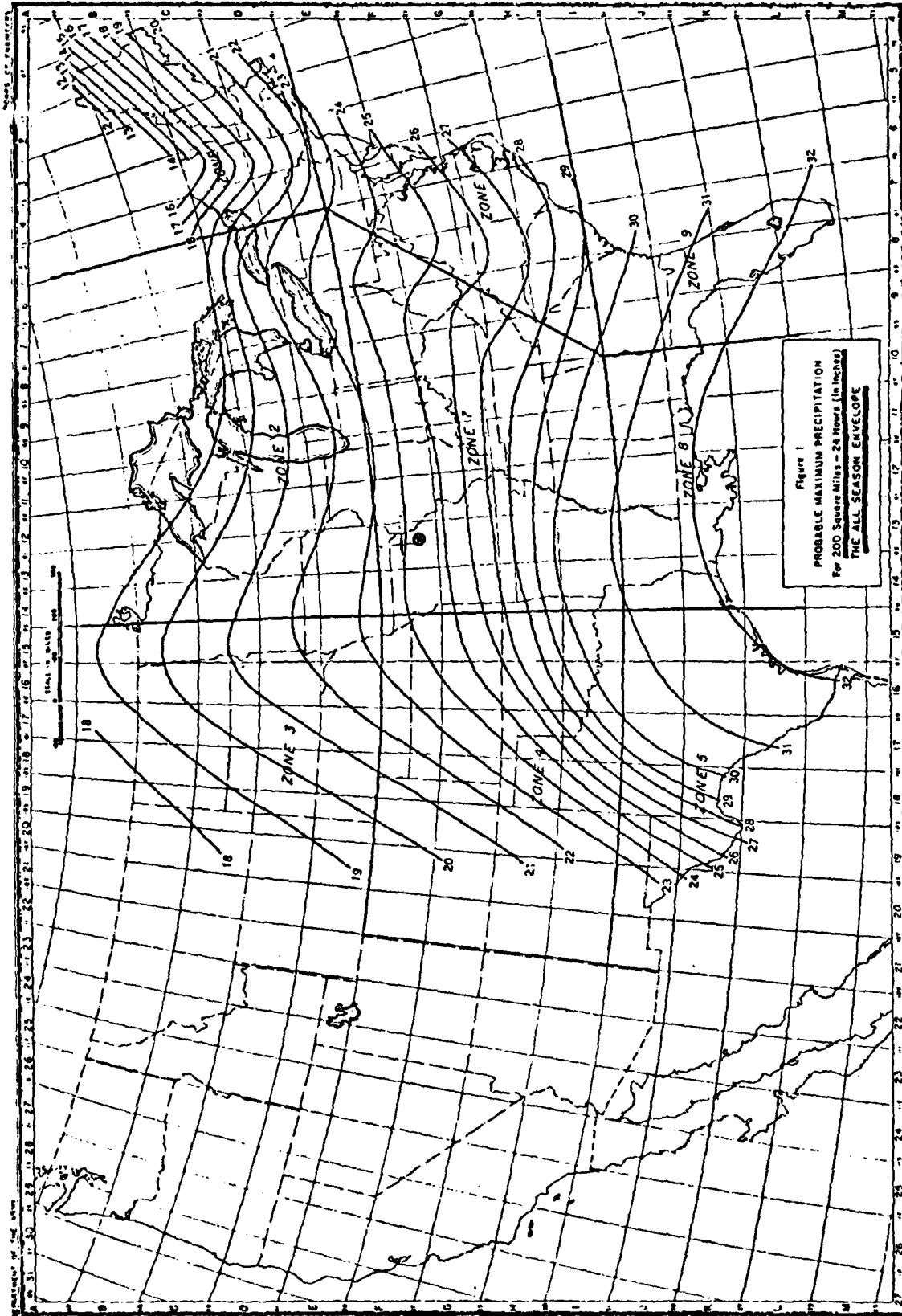
3. DETERMINE BASIN RAINFALL IN TERMS OF PERCENTAGE

OF PMP INDEX RAINFALL FOR VARIOUS DURATIONS:

LOCATION LONG = $91^{\circ}43'25''$ LAT. = $39^{\circ}37'31''$

⇒ ZONE 7

DURATION (HRS)	PERCENT OF INDEX RAINFALL	TOTAL RAINFALL (IN.)	RAINFALL INCREMENTS	DURATION OF INCREMENTS
6	100	24.3	24.3	6
12	120	29.2	4.9	6
24	130	31.6	2.4	12



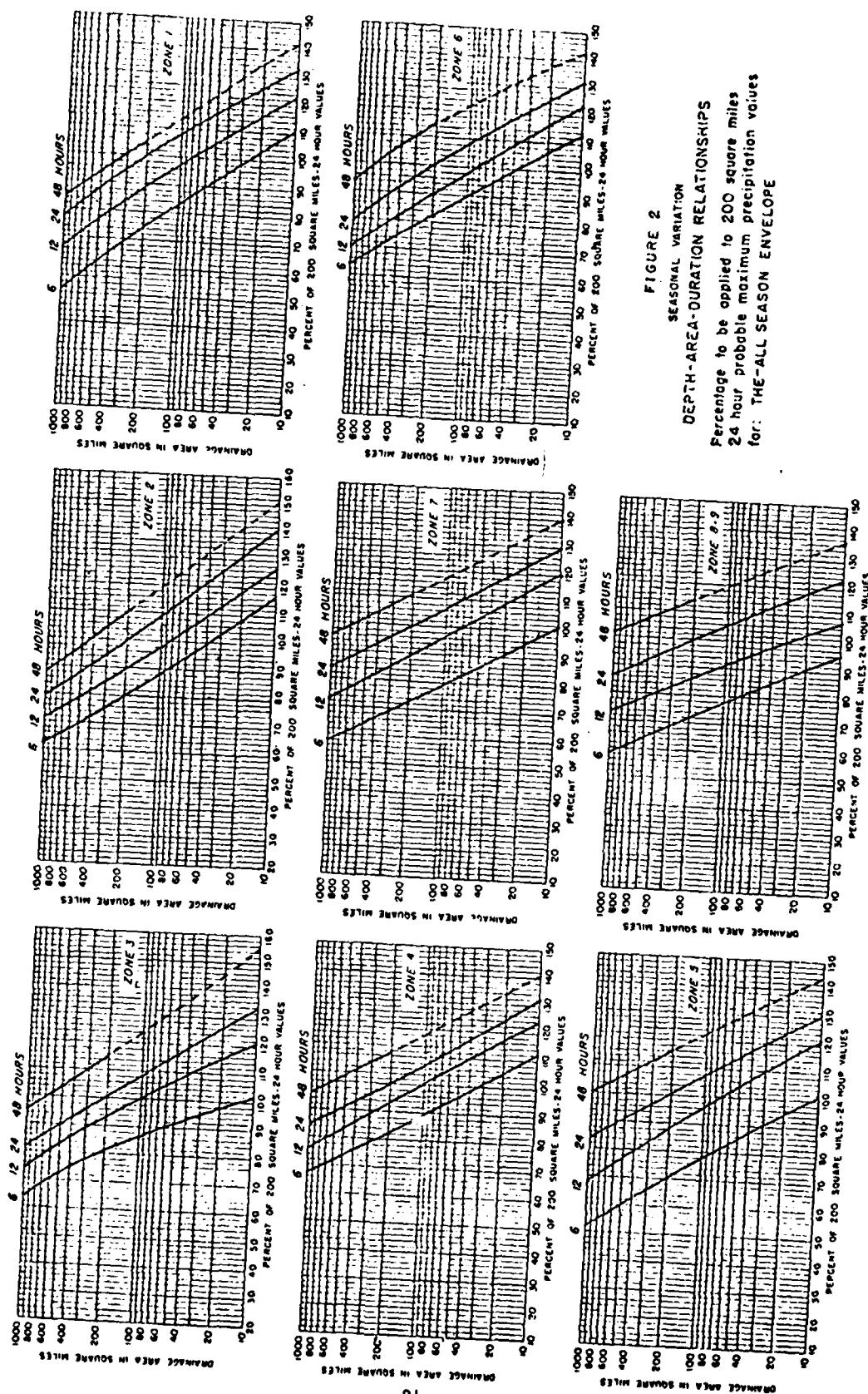


FIGURE 2
SEASONAL VARIATION
DEPTH-AREA-DURATION RELATIONSHIPS
 Percentage to be applied to 200 square miles
 24 hour probable maximum precipitation values
 for: THE-ALL SEASON ENVELOPE

DAM SAFETY INSPECTION - MISSOURI

SHEET NO. 1 OF

DAM # MO. 10538

JOB NO. 1240

UNIT HYDROGRAPH PARAMETERS

BY DNZ
MBV DATE 6/11/73
6/22/73

1. DRAINAGE AREA, $A = 668 \text{ ACRES} = 1.04 \text{ SQ. MI.}$
2. LENGTH OF STREAM, $L = 0.6 \text{ MILES} = 3168 \text{ FT}$
3. ELEVATION AT DRAINAGE DIVIDE ALONG LONGEST STREAM
 $H_1 = 737 \text{ FEET}$
4. RESERVOIR ELEVATION AT SPILLWAY CREST, $H_2 = 713 \text{ FEET}$
5. DIFFERENCE IN ELEVATION, $\Delta H = 24 \text{ FEET}$
6. AVERAGE SLOPE OF STREAM = $\frac{\Delta H}{L} = \frac{24}{3168} = 0.76\%$
7. TIME OF CONCENTRATION :

a) BY KIRPICH FORMULA:

$$T_c = \left(\frac{11.9 \times L^3}{\Delta H} \right)^{0.385} = \left(\frac{11.9 \times 0.6^3}{24} \right)^{0.385} = 0.42 \text{ HR}$$

b) BY VELOCITY ESTIMATE: SLOPE = 0.8%; AVG VEL = 2 FPS

$$T_c = \frac{L}{V} = \frac{3168}{2(60 \times 60)} = 0.44 \text{ HR}$$

USE $T_c = 0.42 \text{ HR}$ 8. LAG TIME, $L_t = 0.6 \times 0.42 = 0.25 \text{ HR}$ 9. UNIT DURATION, $D \leq \frac{L_t}{3} = \frac{0.25}{3} = 0.083 = 0.083$ USE $D = 0.083 \text{ HR} = 5 \text{ MIN}$ 10. TIME TO PEAK, $T_p = \frac{D}{2} + L_t = \frac{0.083}{2} + 0.25 = 0.292 \text{ HR}$ 11. PEAK DISCHARGE, $q_p = \frac{404 A}{T_p} = \frac{404 (1.04)}{0.292} \Rightarrow$

$$q_p = 1724 \text{ CFS}$$

ECI A ENGINEERING CONSULTANTS, INC.

DAM SAFETY INSPECTION / MISSOURI

SHEET NO. 1 OF

MONROE CITY SOUTH LAKE DAM (MO. 10538) JOB NO. 1240-001

HYDROLOGIC SOIL GROUP AND CURVE NUMBER BY MAS DATE 7-29-79

MONROE CITY SOUTH LAKE DAM

DETERMINATION OF HYDROLOGIC SOIL GROUP & SCS CURVE NUMBER

1. The Soils in the watershed consist of Group 'D' soils.
2. Landuse pattern in the watershed seem to be mostly agricultural with some forested areas. Assume hydrologic condition as "Fair".

Thus $CN = 86$ for Soil group D & AMC-II

$\Rightarrow CN = 94$ for AMC-III

ECI-4 ENGINEERING CONSULTANTS, INC.

DAM SAFETY INSPECTION - MISSOURI

SHEET NO. 1 OF

MONROE CITY S. LAKE DAM (105JB) JOB NO. 1240-001-1

100 YR FLOOD BY REGRESSION EQUATION. BY HLB DATE 6-26-79

MONROE CITY S. LAKE DAM100 YR FLOOD BY REGRESSION EQUATIONREGRESSION EQUATION FOR 100-YR FLOOD FOR
MISSOURI:

$$Q_{100} = 85.1 A^{0.934} S^{-0.576}$$

WHERE

A = DRAINAGE AREA IN SQ. MI.

S = MAIN CHANNEL SLOPE FT/MI.
(AUG. SLOPE BETWEEN 0.1L & 0.85L)

FOR MONROE CITY S. LAKE DAM:

A = 1.04 SQ. MI.

S = 42 FT/MI

$$Q_{100} = (85.1)(1.04)^{0.934(1.04)^{-0.002}} (42)^{0.576}$$

$$Q_{100} = \underline{\underline{760 \text{ CFS.}}}$$

HEC-IDB INPUT DATA

INFLOW PMF AND ONE-HALF PMF HYDROGRAPHS

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

4000 FT HYDROGRAPH AT 1053a
2000 FT HYDROGRAPH TO 1053a
END OF NETWORK

ELWOOD HYDROGRAPH PACKAGE (WEC-1)
DATA SERVICY VERSION 1.0 JULY 1970
LAST MODIFICATION 26 FEB 70

RUN DATE: 20/07/70
TIME: 13:15:00

DAM SAFETY INSPECTION - MISSOURI
PORT OF CITY S. LAKE DAV (10530)

PERCENT OF PERCENT H2O DETERMINATION AND REQUIREMENT

No.	Spec	Unit	Value	Job Specification
100	5	MIN	100	100
		MIN	0	0
	100	HR	0	0
		HR	0	0
	100	DAY	0	0
		DAY	0	0
	100	WEEK	0	0
		WEEK	0	0
	100	MONTH	0	0
		MONTH	0	0
	100	YEAR	0	0
		YEAR	0	0

MULTI-POINT ANALYSES TO BE PERFORMED
SPHERE 1, RATIO 2, LATIO 1

SPHERE 2, RATIO 2, LATIO 1

SUB-AREA: RUTGERS COMPUTATION

INPUT PHM, INHY, RAINFALL, RATIO, AND SCA UNIT HYDROGRAPH, PARAMETERS.

INHY	ICOM	ICOM	INHY	JP1	JP1	INHY	INHY	INHY
10530	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10530	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04

HYDROGRAPH DATA

INHY	10530	10530	10530	10530	10530	10530	10530	10530
1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04

PFE	PMS	R6	R6	R12	R24	P48	P72	P96
5.000	24.00	100.00	126.00	110.00	0.00	0.00	0.00	0.00
0.000	0.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00

INHY	10530	10530	10530	10530	10530	10530	10530	10530
1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04

PFE	STP1							
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

CURVE NO. 2 - 99.00 HGTNESS = -1.00 EFFECT CH = 44.00

UNIT HYDROGRAPH DATA

FC= 0.00 LAGE= 25

RECSSION DATA

STATO= 0.400 QRECSD= 0.00

AFTER LOAD

UNIT HYDROGRAPH 1/1 END OF PERIOD COORDINATES, Tcs, 0.00 HOURS, VAB, 0.25 VOL 1.000

305. 1044. 1662. 1275. 775. 980. 312. 194. 122.

164. 161. 304. 119. 113. 111.

B-17

PERIOD	NO. OF MON.	END-OF-PERIOD FLOW		PERIOD	EXS	LOSS	EXPS	LOSS	PERIOD
		COMP C	COMP D						
1	1	0.01	0.01	1	1.01	12.01	1.01	1.00	1
2	2	0.01	0.01	2	1.01	12.01	1.01	1.00	2
3	3	0.01	0.01	3	1.01	12.01	1.01	1.00	3
4	4	0.01	0.01	4	1.01	12.01	1.01	1.00	4
5	5	0.01	0.01	5	1.01	12.01	1.01	1.00	5
6	6	0.01	0.01	6	1.01	12.01	1.01	1.00	6
7	7	0.01	0.01	7	1.01	12.01	1.01	1.00	7
8	8	0.01	0.01	8	1.01	12.01	1.01	1.00	8
9	9	0.01	0.01	9	1.01	12.01	1.01	1.00	9
10	10	0.01	0.01	10	1.01	12.01	1.01	1.00	10
11	11	0.01	0.01	11	1.01	12.01	1.01	1.00	11
12	12	0.01	0.01	12	1.01	12.01	1.01	1.00	12
13	13	0.01	0.01	13	1.01	12.01	1.01	1.00	13
14	14	0.01	0.01	14	1.01	12.01	1.01	1.00	14
15	15	0.01	0.01	15	1.01	12.01	1.01	1.00	15
16	16	0.01	0.01	16	1.01	12.01	1.01	1.00	16
17	17	0.01	0.01	17	1.01	12.01	1.01	1.00	17
18	18	0.01	0.01	18	1.01	12.01	1.01	1.00	18
19	19	0.01	0.01	19	1.01	12.01	1.01	1.00	19
20	20	0.01	0.01	20	1.01	12.01	1.01	1.00	20
21	21	0.01	0.01	21	1.01	12.01	1.01	1.00	21
22	22	0.01	0.01	22	1.01	12.01	1.01	1.00	22
23	23	0.01	0.01	23	1.01	12.01	1.01	1.00	23
24	24	0.01	0.01	24	1.01	12.01	1.01	1.00	24
25	25	0.01	0.01	25	1.01	12.01	1.01	1.00	25
26	26	0.01	0.01	26	1.01	12.01	1.01	1.00	26
27	27	0.01	0.01	27	1.01	12.01	1.01	1.00	27
28	28	0.01	0.01	28	1.01	12.01	1.01	1.00	28
29	29	0.01	0.01	29	1.01	12.01	1.01	1.00	29
30	30	0.01	0.01	30	1.01	12.01	1.01	1.00	30
31	31	0.01	0.01	31	1.01	12.01	1.01	1.00	31
32	32	0.01	0.01	32	1.01	12.01	1.01	1.00	32
33	33	0.01	0.01	33	1.01	12.01	1.01	1.00	33
34	34	0.01	0.01	34	1.01	12.01	1.01	1.00	34
35	35	0.01	0.01	35	1.01	12.01	1.01	1.00	35
36	36	0.01	0.01	36	1.01	12.01	1.01	1.00	36
37	37	0.01	0.01	37	1.01	12.01	1.01	1.00	37
38	38	0.01	0.01	38	1.01	12.01	1.01	1.00	38
39	39	0.01	0.01	39	1.01	12.01	1.01	1.00	39
40	40	0.01	0.01	40	1.01	12.01	1.01	1.00	40
41	41	0.01	0.01	41	1.01	12.01	1.01	1.00	41
42	42	0.01	0.01	42	1.01	12.01	1.01	1.00	42
43	43	0.01	0.01	43	1.01	12.01	1.01	1.00	43
44	44	0.01	0.01	44	1.01	12.01	1.01	1.00	44
45	45	0.01	0.01	45	1.01	12.01	1.01	1.00	45
46	46	0.01	0.01	46	1.01	12.01	1.01	1.00	46
47	47	0.01	0.01	47	1.01	12.01	1.01	1.00	47
48	48	0.01	0.01	48	1.01	12.01	1.01	1.00	48
49	49	0.01	0.01	49	1.01	12.01	1.01	1.00	49
50	50	0.01	0.01	50	1.01	12.01	1.01	1.00	50
51	51	0.01	0.01	51	1.01	12.01	1.01	1.00	51
52	52	0.01	0.01	52	1.01	12.01	1.01	1.00	52
53	53	0.01	0.01	53	1.01	12.01	1.01	1.00	53
54	54	0.01	0.01	54	1.01	12.01	1.01	1.00	54
55	55	0.01	0.01	55	1.01	12.01	1.01	1.00	55
56	56	0.01	0.01	56	1.01	12.01	1.01	1.00	56
57	57	0.01	0.01	57	1.01	12.01	1.01	1.00	57
58	58	0.01	0.01	58	1.01	12.01	1.01	1.00	58
59	59	0.01	0.01	59	1.01	12.01	1.01	1.00	59
60	60	0.01	0.01	60	1.01	12.01	1.01	1.00	60
61	61	0.01	0.01	61	1.01	12.01	1.01	1.00	61
62	62	0.01	0.01	62	1.01	12.01	1.01	1.00	62
63	63	0.01	0.01	63	1.01	12.01	1.01	1.00	63
64	64	0.01	0.01	64	1.01	12.01	1.01	1.00	64
65	65	0.01	0.01	65	1.01	12.01	1.01	1.00	65
66	66	0.01	0.01	66	1.01	12.01	1.01	1.00	66
67	67	0.01	0.01	67	1.01	12.01	1.01	1.00	67
68	68	0.01	0.01	68	1.01	12.01	1.01	1.00	68
69	69	0.01	0.01	69	1.01	12.01	1.01	1.00	69
70	70	0.01	0.01	70	1.01	12.01	1.01	1.00	70
71	71	0.01	0.01	71	1.01	12.01	1.01	1.00	71
72	72	0.01	0.01	72	1.01	12.01	1.01	1.00	72
73	73	0.01	0.01	73	1.01	12.01	1.01	1.00	73
74	74	0.01	0.01	74	1.01	12.01	1.01	1.00	74
75	75	0.01	0.01	75	1.01	12.01	1.01	1.00	75
76	76	0.01	0.01	76	1.01	12.01	1.01	1.00	76
77	77	0.01	0.01	77	1.01	12.01	1.01	1.00	77
78	78	0.01	0.01	78	1.01	12.01	1.01	1.00	78
79	79	0.01	0.01	79	1.01	12.01	1.01	1.00	79
80	80	0.01	0.01	80	1.01	12.01	1.01	1.00	80
81	81	0.01	0.01	81	1.01	12.01	1.01	1.00	81
82	82	0.01	0.01	82	1.01	12.01	1.01	1.00	82
83	83	0.01	0.01	83	1.01	12.01	1.01	1.00	83
84	84	0.01	0.01	84	1.01	12.01	1.01	1.00	84
85	85	0.01	0.01	85	1.01	12.01	1.01	1.00	85
86	86	0.01	0.01	86	1.01	12.01	1.01	1.00	86
87	87	0.01	0.01	87	1.01	12.01	1.01	1.00	87
88	88	0.01	0.01	88	1.01	12.01	1.01	1.00	88
89	89	0.01	0.01	89	1.01	12.01	1.01	1.00	89
90	90	0.01	0.01	90	1.01	12.01	1.01	1.00	90
91	91	0.01	0.01	91	1.01	12.01	1.01	1.00	91
92	92	0.01	0.01	92	1.01	12.01	1.01	1.00	92
93	93	0.01	0.01	93	1.01	12.01	1.01	1.00	93
94	94	0.01	0.01	94	1.01	12.01	1.01	1.00	94
95	95	0.01	0.01	95	1.01	12.01	1.01	1.00	95
96	96	0.01	0.01	96	1.01	12.01	1.01	1.00	96
97	97	0.01	0.01	97	1.01	12.01	1.01	1.00	97
98	98	0.01	0.01	98	1.01	12.01	1.01	1.00	98
99	99	0.01	0.01	99	1.01	12.01	1.01	1.00	99
100	100	0.01	0.01	100	1.01	12.01	1.01	1.00	100

B-18

B-19

B-20

SUMMARY OF PMF AND ONE-HALF PMF FLOOD ROUTING

PEAK FLOW AND STORAGE (IN OF PERIOD) SUMMARY FOR MULTIPLE PLATE-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SAUER FEET (AREA IN METERS)

STATION	STATION	AREA	PERIOD	RATIO	RATIOS APPLIED TO FLOWS
100.000	100.000	100.000	1	987.	4.000.
100.000	100.000	100.000	1	756.	3.500.

B-24

SUMMARY OF IAHM SAFETY ANALYSIS

IB-25

AD-A104 619

CONSOER TOWNSEND AND ASSOCIATES LTD ST LOUIS MO
NATIONAL DAM SAFETY PROGRAM. MONROE CITY SOUTH LAKE DAM (MO1053--ETC(U))
NOV 79 W G SHIRIN

F/0 13/13

DACW43-79-C-0075

ML

UNCLASSIFIED

2
2000-0



END

DATE

FILED

40-811

OTIC

PERCENT OF PMF FLOOD ROUTING
EQUAL TO SPILLWAY CAPACITY

B-26

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

HUMUUF HYDROGRAPH AT - 10518
ROUTE HYDROGRAPH TO - 17538
END OF NETWORK

PEAK OUTPUT IS 1778. AT TIME 16.04 HOURS

B-30

TABLE II
SUMMARY FOR MULTIPLE BLANKET-FACTOR ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND ACCORDING TO AREA IN SQUARE MILES (SQUARE MILES PER SECOND)

B-3

SUMMARY OF DARK COFFEE ANALYSIS

B-32

FILME

